LECTURES ON SURGERY

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LECTURES

ON

SURGERY

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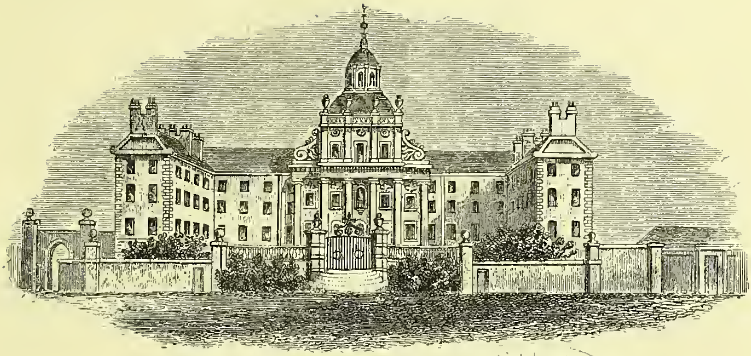

PREFACE TO SECOND EDITION.

THE former edition having been exhausted, this, the Second Edition, has been prepared so as to bring the Lectures up to the present state of Surgery. Whilst I have adhered to the plan of the work and the method of teaching explained in the Preface to the first edition, the whole has been carefully revised, some parts re-written, and much new matter added. In doing this, as well as in the general revision of the work, I have been much indebted to the assistance of my friend and former pupil, Mr. D. J. CUNNINGHAM. The Structural Classification of Tumours is entirely written by him. I have in this edition carried out more fully the plan of appending illustrative Clinical Cases, with remarks, to the different sections of the Lectures; so that, whilst the book serves as a Text-book for my Class, I am not without hope that it may also prove useful as a work of reference for practitioners.

Whilst I have retained the plates and chromolithographs of the former edition, I have added a large number of wood-

cuts. Of these a considerable number are from original sketches by my late Resident Surgeon, Mr. J. H. Scott; others are drawn from photographs by Mr. Ramage, and nearly all the new woodcuts are executed by him. I have also availed myself of other wood-engravings placed at my disposal by the publishers.

In conclusion, my acknowledgments are due to Dr. Braidwood for the valuable abstract which he furnished me of the results of his researches on Pyæmia.

JAMES SPENCE.

November 1875.

PREFACE TO FIRST EDITION.

The publication of these Lectures on Surgery was undertaken with the view of placing in the hands of my Students a Text-book for the Class, and also in consequence of a desire, often expressed by many of my old pupils, that I should enable them to possess in a published form the Principles and Practice which I had orally taught them. Another inducement to undertake the task was the consideration that, when I had placed in the hands of my Students a general view of the Principles and Practice of Surgery, I would be left at greater freedom to vary the method of teaching, and to devote more time to particular departments, more especially to Regional Surgery, and to teaching the Student the method of applying his knowledge of healthy and morbid anatomy to the investigation and diagnosis of surgical disease, as well as to its treatment—a kind of instruction which my experience as a Surgical Teacher and Hospital Surgeon has shown me to be much required.

The arrangement of the subjects treated of is that which I have hitherto adopted as being best suited for giving a view of Surgery as a whole. The First Division consists in a general view of different forms of Diseased Action, Inflammation and its results, Tumour Growth and the different forms of Tumours, Syphilis, and External Injuries and their consequences. The Second Division treats of Diseases and Injuries of Special Stuctures; the Diseases and Injuries of the Osseous, Articular, Muscular, and Vascular systems. The Third Division is devoted to the consideration of Regional and Operative Surgery; that is, the special diseases and injuries occurring in the different regions of the body, and the operations required for their relief. In connection with the Second and Third Divisions of the course, Clinical Cases are given, illustrative of the doctrine taught and the treatment advised in the Lectures. In regard to Ophthalmic Surgery, the time which can be devoted to it in a Course of Lectures on general Surgery is so limited as to be quite inadequate for doing

justice to such an important subject, and I therefore determined to omit it altogether from my published Lectures.

The number of these Lectures will be enough to show that they were not all delivered during any single course; the period now allotted for the winter session necessitating the omission of particular subjects, or parts of the course, in different years. The short-hand notes taken by my former pupil Dr. Ballingall Stewart, during the session 1866-7, have been used as the basis; and these, together with class notes kindly furnished me by former pupils, together with my own heads of Lectures, and published and unpublished papers on special departments of Surgery, have been used in preparing the work as now issued. The publication of the subjects taught in the original Lecture-form may seem of doubtful propriety. The style used in oral instruction is, in a literary point of view, essentially faulty, owing to the colloquial expressions and the tendency to tautology almost inseparable from it, when speaking of matters such as those discussed in a course of Surgery; but whatever such a practical subject loses in elegance of style, seems to me to be more than counterbalanced by the directness and individuality of the teaching. For my own part, I confess that I have always found more interest in, and more direct instruction from discourses or Lectures on Surgery, than from the systematic treatises, however elegant the composition of the latter.

In teaching, I have adopted what may by many be considered too dogmatic a method; but the necessity for this has been long impressed on me by experience as a Teacher and as an Examiner at different Medical Boards. The multiplicity of subjects which engage a Student's attention leaves him but little time to weigh and decide controverted points, even supposing him to possess the knowledge requisite for such decision, and hence I think he has a right to look to the Lecturer for distinct definite instruction, founded on a fair and truthful digest of his own experience. Consequently, wherever I have to discuss different methods of treatment, I feel myself bound to tell my pupils precisely how I should act under the circumstances. After thirty-five years' Surgical practice, twenty-two of them spent as a Lecturer on Surgery and an Hospital Surgeon, I feel that I may claim some right to state decidedly the opinions which I hold, and the practice which I have found from experience to be most successful.

It may be thought that I have in some instances entered more fully on anatomical details than necessary, now that so much attention is given to the study of Anatomy. But practically, I

know that it is quite possible for a Student to have a good knowledge of Anatomy, and yet not to be versed in applying that knowledge to the practice of Surgery. Surgical Anatomy, properly understood, implies not merely relation of parts, but such an acquaintance with the position, functions, and relations of the structures entering into the formation of any region, as may assist in the diagnosis and treatment of the injuries and diseases occurring in it; or in certain cases to judge how far operative interference is warrantable, and guide us if it be, in planning and performing the operation. Hence, I only regret that the nature of the course limited the amount of such teaching to little more than suggestive hints.

The range of subjects treated of in these Lectures is so large as to render it quite impossible to enter fully upon all. I have therefore devoted more space to the important subjects, in which, from various circumstances, I have had an exceptionally large experience, such as Tumours, Diseases of the Vascular System, Excisions of Joints, Amputation, Injuries of the Head, Diseases and Injuries of the Air Passages, Hernia, and Diseases of the Urinary Organs. Even in regard to these the Lectures are necessarily suggestive, not exhaustive, as in the case of monographs; the other parts of the work, again, though more briefly treated, will be found to contain all that is essential or of practical interest.

In conclusion, I have to acknowledge the assistance afforded me by my friend Dr. Taylor, in preparing for the press and compiling the Index, and to Dr. Thomas Balfour, for his assistance in the revision of the latter portion of the work. In regard to the artistic department, I am specially indebted to the kind offices of my friend Dr. John Smith. And here I would draw attention to the mode of illustration adopted, as preferable to the ordinary woodcuts, both in respect to the perspicuity afforded by colour, as well as enabling me to give faithful transcripts from photographs, or from original sketches made by various artistic friends, of actual cases or dissections, and used by me as class illustrations in my Lectures at the University.

April 1871.

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LECTURE LXVI.

CLINICAL CASES.

Clinical Cases illustrative of the Subject of Fracture and Dislocation.

EXPLANATION OF PLATES.

INFLAMMATION.—Plate I.—Page 2.

This plate is intended to illustrate the appearances exhibited in inflammation of the eye, in contrast with those seen in its natural condition. See Lecture I.

Fig. 1. *Acute conjunctivitis.* Stage of active congestion. Increased redness due to increased vascularity. The vessels of the conjunctiva obviously enlarged and arborescent.

Fig. 2. *Chemosis.* The conjunctiva of an almost uniform red colour. Swollen, puckered, and pushed forward, owing to the passive congestion or stasis with effusion into the membrane and connective tissue between it and the sclerotic.

Fig. 3. Healthy eye.

Fig. 4. *Iritis.* Deep-seated inflammation of the eye. The appearance of vascularity is modified by the dense structure of the sclerotic. The zone round the cornea is due to the anatomical arrangement of the bloodvessels. The phenomenon of exudation is seen in the mass of effused lymph, situated on the pupillary margin of the iris.

Fig. 5. *Corneitis.* Showing the modification of the appearances of inflammation in a non-vascular structure ; there is neither redness nor vascularity in the cornea, but it has become opaque from exudation into its structure. See Lecture I. pp. 2-3.

SUPPURATION.—Plate II.—Page 20.

Fig. 1. Acute diffuse abscess of arm and forearm, treated by openings and counter-openings. Drainage-tubes introduced so as to favour escape of discharge, and to facilitate the washing out of the cavity of the abscess.

Fig. 2. Acute circumscribed abscess of forearm, pointing towards the surface The form of the abscess shows the circumscription of the purulent collection, and the bright red colour shows the acute action in contrast with that of the chronic abscess. Fig. 4.

Fig. 3. Chronic abscess of hip, opened by the method described at page 27. (Sketched by Dr. John Smith.)

Fig. 4. Large chronic or cold abscess of upper part of thigh. From a case in the Royal Infirmary. (Sketched by Mr. Coughtrey.)

MORTIFICATION.—Plate III.—Page 60.

Fig. 1. Traumatic gangrene of hand, caused by great violence; mortification followed rapidly on the injury, and amputation was successfully performed at about the middle of the forearm, before the constitutional symptoms became severe. Case alluded to at page 63.

Fig. 2. Dry senile gangrene of hand and forearm. The parts are seen dry and withered, whilst there is but little action above the line of demarcation. (Sketched by Dr. Richard Caton.)

Fig. 3. Chronic gangrene arising from cold. The natural process of separation between the dead and the living parts is well shown. All the textures, except the bone, being divided at the upper line of demarcation. On the dorsal aspect of the foot, in the tarsal region, there is a deep line of demarcation, where nature had first attempted separation. The leg was amputated at some distance above the upper line of separation, so as to afford material for the formation of an efficient stump. See page 68.

Fig. 4. Irritable senile gangrene of toes (Pott's gangrene). The mortified parts are more humid than in the dry senile gangrene. The neighbouring parts are swollen, red, and irritable.

ERYSIPELAS.—Plate IV.—Page 70.

Fig. 1. Appearances characteristic of Erysipelas of the head and face. The features and expression altered by the inflammatory swelling and effusion in the loose tissues, and by interference with the action of the muscles of expression. Small abscesses have formed in the eyelids, and vesications on the cheeks.

Fig. 2. Erysipelas of leg and foot. Showing the diffuse character of the inflammatory redness. On the leg are seen vesications caused by the vessels of the skin relieving themselves by effusion between it and the cuticle. In the foot there is acute œdema, owing to the effusion taking place most easily into the loose connective tissue of that region. (Sketched by Dr. John Smith.)

TUMOURS.—Plate V.—Page 84.

Exhibits contrasts between simple and malignant tumours.

The contrast in the physiognomy is the most obvious, as shown in the painfully anxious and worn-out expression of the features in Fig. 2, as compared with the perfectly placid expression in the case of simple growth No. 1. Another point of contrast is the comparative want of definition in the malignant tumour, Fig. 2.

Fig. 1 is from a photograph of Mrs. Jepson, whose case is alluded to at p. 90. The tumour was sixteen years in attaining the bulk shown in the plate.

Fig. 2 is from a photograph of a patient who was under my care in the Royal Infirmary. In her case the tumour developed itself in less than eighteen months, and was attended with great pain.

TUMOURS.—Plate VI.—Page 114.

Osteosarcomatous Tumour of Forearm, described at p. 114.

WOUNDS.—Plate VII.—Page 147.

Fig. 1. Sketch of a wounded soldier. The ball entered in the forehead, penetrated the skull and drove up the bone, elevating two portions at an angle. (From sketch by the late Sir Charles Bell. Finished oil-painting in Museum of Royal College of Surgeons, Edinburgh.)

Fig. 2. Sketch showing the apparently eccentric course of a bullet. When the arm is extended it presents the appearance of having been penetrated by two separate balls instead of one. This is due to the position in which the arm was when wounded. That position is indicated by the dotted outline. The bullet entered the back of the wrist, came out at the front of the forearm, re-entered the front of the arm, and ultimately was lodged under the skin at the back of the upper arm—p. 160.

Fig. 3. Sketch showing nature of wound inflicted by a charge of small shot when fired close to the part. The aperture of entrance is small and well defined, not unlike that caused by a bullet. The aperture of exit is large and irregular, the textures being torn up by the shot, from the expansion of the charge in passing through them—pp. 161.

Fig. 4. Sketch of penetrating bayonet wound, illustrating the appearance of punctured wounds in general. The form of wound is caused by the triangular shape of the weapon. The edges are slightly inverted, and so contracted by the elasticity of the skin as merely to represent three lines meeting in the centre. The darkness is caused by extravasation of blood under the integument. This wound penetrated the liver, diaphragm, and lung. The peculiar expression of face is the effect of these internal lesions. (From a patient, L'Hôpital de la Charité, Paris, sketched by Dr. John Smith, Feb. 1850.)

WOUNDS.—Plate VIII.—Page 169.

The sketches in this plate exhibit the immediate and secondary effects of gunshot wounds in the shaft of a long bone. (The specimens are in the Alcock Collection in the University of Edinburgh.)

Fig. 1. Gunshot fracture of femur. The large and somewhat square opening marks the exit of the ball; whilst a longitudinal fissure extends upwards from it, with transverse fissure lower down.

Fig. 2. Gunshot fracture of tibia. The aperture of entrance of the ball is shown. Longitudinal, transverse, and irregular fissures are seen extending from the wound in all directions, showing the extensive comminution in such cases.

Figs. 3 and 4 are different views of the same bone. They exhibit the abortive attempts at repair in a case of gunshot fracture of the femur. The extensive comminution and death of the comminuted fragments reveal the causes of failure. The limb required to be amputated fifty-three days after the injury.

WOUNDS.—Plate IX.—Page 170.

Figures 1, 2, 3, and 4, exhibit the effects of bullet-wounds in the cancellated structure of the articular extremities of long bones.—See Lecture xxviii.

Fig. 1. Ball lodged in the articular end of humerus at the junction of its head with the tuberosities, and splintering the bone into the shoulder-joint. An attempt was made to save the limb, but the patient died on the eleventh day. This is a typical case for primary excision.

Fig. 2. Elbow-joint in which the ball passed obliquely through the external condyle of humerus, not perceptibly fissuring the bone. Complete bony anchylosis took place, but a form of caries supervened. Amputation was necessitated one hundred and thirty-six days after the injury. This is a beautiful specimen of the perforating wounds described by Dupuytren as proper cases for attempting to save the limb. It is one of a class I consider specially suitable for primary excision of the elbow. (Sketched by Dr. R. Caton.)

Fig. 3. Lower third of femur, showing a musket-ball lodged a little above the external condyle, just at the junction of the epiphysis. The wound does not implicate the articular surface. Primary amputation was performed. This is one of the cases suitable for extracting the ball, gouging out the surrounding cancellated texture, and trying to save the limb. (Sketched by Dr. R. Caton.)

Fig. 4 is a similar injury in the head of the tibia. There was no shattering of the bone, but there was slight fissure of the articular surface ; so that primary excision might be preferable in such a case Amputation was performed eighteen hours after the injury.

Fig. 5. Thumb injured by the bursting of a fowling-piece. The clean defined lines of the divided skin were cut by the fragments of the gun-barrel, a mere touch of the knife being required to disarticulate the thumb—Case referred to in Lecture xxvii., p. 164. (Sketched by Dr. R. Caton.)

WOUNDS.—Plate. X.—Page 182.

Fig. 1. A patient in the condition termed Opisthotonos. (From a sketch by the late Sir Charles Bell. The finished oil-painting is in the Museum of the Royal College of Surgeons.)

Fig. 2. Diagram of the tepid bath treatment of lacerated or gunshot wounds, or compound fractures ; described in Lecture xxv., pp. 153-4.

Fig. 3. A case of tetanus, lately in the Royal Infirmary. It illustrates the peculiar expression of the features, and rigid contraction of the hand and arm, whilst the contracted state of the eyelids will correct the impression made by the widely-open eye in Sir C. Bell's sketch, as that condition is unusual. (From a sketch by Dr. John Smith.)

DISEASES OF BONES AND JOINTS.—Plate XI.—Page 214.

Fig. 1. Acute Necrosis of Tibia.—The limb, which was amputated on account of Secondary disease of the knee-joint, was minutely injected with vermilion size. The Sketch shows the extremely vascular and thickened and fleshy state of the periosteum, contrasting with the white surface of the dead bone. At one point, where a scale of the external shell of the bone has separated with the periosteum, the underlying bone is seen to be highly vascular. (Sketched, from nature, by Mr. Livesay.)

Fig. 2. Natural process of extrusion of a large sequestrum of the tibia. The extent of extrusion here shown was accomplished in sixteen years from the commencement of the disease. The deformity of the limb from solid œdema and deposit of new bone is well exemplified. (Sketched, from nature, by Dr. John Smith.) See Lectures.

Fig. 3. Specimen of the condition termed ulceration of cartilage. The synovial membrane is unaffected. The cartilage of incrustation is in process of ulceration, and the subjacent osseous articular surface is exposed, in a highly vascular and inflamed state. (Drawn on stone, from nature.)

Fig. 4. Knee-joint, exhibiting the strumous degeneration of the synovial membrane. The morbid deposit has invaded almost the entire synovial surface, covering in the articular cartilaginous surfaces, except at one or two points, and at one part has caused ulceration of the cartilage, and exposure of subjacent bone. (Drawn on stone, from nature.)

NECROSIS AND CARIES.—Plate XII.—Page 231.

Fig. 1. Specimen of necrosis of tibia, in which a large sequestrum of the shaft separated. The sequestrum is seen imprisoned and bridged over by the deposit of new bone. It was removed by dividing it with cutting-pliers, and taken away in two pieces so as to save the new bone. Disease of the knee and ankle joints subsequently necessitated amputation. The sequestrum has been replaced; the line of section made for its removal is seen on it. (Drawn on stone, from nature.)

Fig. 2. Large sequestrum from the fibula, the result of acute necrosis in a child. It involved nearly the whole extent of the fibula, and approaches nearer than any specimen I have seen to complete death of a bone: at the same time, it will be observed that portions of living bone have separated both at the upper and lower extremities of the fibula. (Drawn on stone, from nature.)

Fig. 3. Cario-necrosis of os calcis.—A carious cavity is seen in the anterior part of the bone; whilst, posteriorly, a large sequestrum of cancellated texture is lying loose. The surface of the cavity in which the sequestrum lies is carious. The portion of the os calcis between the two carious cavities is dense and smooth like ivory, the condition described by Goodsir. (Drawn on stone, from nature.)

Fig. 4. Characteristic specimen of articular caries of the head of humerus, removed by excision. (Drawn on stone, from nature.)

DISEASES OF JOINTS.—Plate XIII.—Page 272.

Fig. 1 shows the appearances present in the early stage of morbus coxarius: the affected hip flattened, the limb apparently lengthened, resting on the toes, the heel elevated, and knee slightly bent.

Fig. 2. Appearances in advanced stage of same disease. Shortening of the limb, projection at hip, with inversion of knee; marks of old abscesses.

Fig. 3 shows one of the altered conditions of the bones in a case of hip-joint disease. The head of femur is absorbed or destroyed, and the acetabulum is carious and altered in form.

Fig. 4. Bracketed long splint used in cases of morbus coxarius, also in compound or complicated fractures of thigh, when we require to dress a wound, or wish to avoid pressure on any part of the limb.

Fig. 5. External appearances in a case of strumous disease of the elbow-joint.

Fig. 6. Chronic thecal bursitis at the wrist. (Sketched from a cast.)

Fig. 7. Ganglion of very large size, situated amongst the extensor tendons on the back of thumb. (Drawn from a cast.)

Fig. 8. Chronic bursitis over patella,—" Housemaid's knee."

Fig. 9. Section of a patellar bursa removed by operation. Its walls are thickened so as to render it nearly solid. Septa run across its cavity, dividing it into cysts. (Drawn from nature.)

Fig. 10. Specimen showing patella, with the bursa over it converted into a solid tumour. (Drawn from nature.)

FRACTURE.—Plate XIV.—Page 288.

Fig. 1. Compound diastasis of the bones of leg. The tibia was separated from its lower epiphysis, stripped of its periosteum, and projected as shown. The posterior tibial vessels and nerve are seen torn and twisted. (Sketched, from nature, from a case under my care in the Royal Infirmary, by S. Mackenzie. Primary amputation was performed.)

Fig. 2. Compound comminuted fracture of the leg,—result of a railway injury. Primary amputation. (Sketched, from nature, by Dr. Caton.)

Plate XV.—Page 294.

Fig. 1. Fracture of neck of scapula. Plastic material has been thrown out, rendering the textures less distinct. The neck of scapula and glenoid cavity are displaced downwards. See Clinical Cases.

Fig. 2. Scapula, showing altered shape of glenoid cavity in an old unreduced dislocation. It is worn away so as to be lunated instead of ovoid, and the worn surface is covered with porcellaneous deposit.

Fig. 3. Specimen of false joint occurring after non-union of fractured clavicle.

Fig. 4. Section of a fracture of distal end of radius, showing union four weeks after accident. There is no redundant or provisional callus; a narrow line of new, nearly ossified material, unites the broken fragments.—Patient died suddenly of apoplexy.

Fig. 5. Specimen of strong fibro-cartilaginous union after intra-capsular fracture of neck of thigh bone. (Drawn on stone, from nature.)

FRACTURE AND DISLOCATION.—Plate XVI.—Page 310.

Fig. 1. Ordinary method of treating fractured clavicle—with axillary pad and handkerchiefs. See page 312.

Fig. 2. Special apparatus for fractures and dislocations of the clavicle.

Fig. 3. Appearance of the shoulder in dislocation of the humerus downwards. Squareness of shoulder and hollow under acromion, as contrasted with the opposite limb.

Fig. 4. Outline and skeleton sketch explanatory of the appearances in fig. 3.

Fig. 5. Outline sketch of appearance of shoulder and position of arm in fracture of the surgical neck of the humerus.

Fig. 6. Diagram explanatory of the deformity, and of the displacing forces in Fig. 5. The head of humerus is little altered in position. *A* indicates the action of the deltoid muscle, tilting out the elbow, and raising and pushing inwards the upper end of the shaft ; *B*, the lines of the pectoralis major, and latissimus dorsi, and teres major dragging the upper end of the shaft in towards the thorax.

Fig. 7. Fracture of humerus put up with Gooche's splints and slip-knot. Fig. 11, a Gooche's splint prepared for such a case. Mr. Courtray.

Fig. 8. Displacing muscular forces in fracture of humerus, when it occurs between the insertion of the deltoid, *A*, and the insertions of the pectoralis major and latissimus dorsi, *B*. See page 321.

Fig. 9. Four-tailed split cloth or bandage used for treating fracture and other injuries of the lower jaw. Mr. Courtray.

Fig. 10. Figure-of-8 bandage and sling, used in cases of fracture through the condyles of humerus, and other injuries of the elbow. Mr. Courtray.

Fig. 12. Apparatus for fracture of the olecranon process. See page 326.

Fig. 13. Fracture of both bones of forearm, put up with Gooche's splints and sling. Page 327. Mr. Courtray.

Fig. 14. Angular pasteboard splints used by Mr. Spence for fracture of the distal end of radius. Page 329. Mr. Courtray.

FRACTURE.—Plate XVII.—Page 333.

Fig. 1. The long splint applied in a case of fractured femur. The sheet fixing the limb to the splint is partially undone to show its mode of application, and the position of the lateral Gooche's splints.

Fig. 2. Inclined plane used in cases of fractured patella.

Figs. 3. and 4. Fracture box apparatus, composed of two narrow pieces of wood and small sheet. Fig. 3 shows the apparatus partly applied ; Fig. 4, a lateral view of the leg when the apparatus is completed.

Fig. 5. Comminuted fracture of tibia, put up on Liston's double-inclined plane splint.

Fig. 6. Back-splint applied, in a case of fracture near the ankle, to prevent retraction of foot (Dupuytren's method). In this figure the back-splint alone is shown, but I generally use narrow pasteboard splints, with foot-pieces, in addition. See page 360.

Fig. 7. Fracture of both bones of leg, treated with lateral pasteboard splints. Limb laid on outer side, with the knee flexed.

Fig. 8. Stirrup-splint applied in a case of fracture near the ankle, to prevent retraction of the foot. Page 360.

Figs. 9. and 10. External appearances, and skeleton view of parts concerned in Pott's Fracture. (Reduced, by photograph, from Pott's original work.)

Fig. 11. Front view of Pott's fracture treated with Dupuytren's splint, showing the inclination given to the foot when the apparatus is adjusted.

Fig. 12. Side view of same apparatus.

Fig. 13. Compound dislocation of ankle treated on the wire splint, slung, and ice-bags applied on each side of joint. The wire splint is very simple, and can be bent to any angle required.

DISLOCATION.—Plate XVIII.—Page 334.

Fig. 1. Dislocation of the femur on the dorsum ilii, or dislocation upwards and backwards.

Fig. 2. Dislocation into the ischiatic notch.

Fig. 3. Dislocation on the pubes.

Fig. 4. Dislocation downwards into the obturator foramen.

Fig. 5. Appearances in a case of fracture of the neck of the femur.

REDUCTION OF DISLOCATION,—Plate XIX.—Page 336.

Fig. 1. Mode of reducing dislocation on the dorsum ilii.

Fig. 2. Reduction of dislocation in the ischiatic notch.

Fig. 3. Method of reducing dislocation in the obturator foramen.

Fig. 4. Mode of reducing dislocation on the pubes.

Fig. 5. Reduction of dislocated humerus by pulling the arm over the heel placed in the axilla.

INJURIES AND DISEASES OF MUSCLES AND TENDONS.—
Plate XX.—Page 372.

Fig. 1. Method of dividing the sterno-mastoid for cure of wry-neck. See page 377.

Fig. 2. Liston's screw lever-splint, used for straightening contracted knee-joint. See pages 258 and 379.

Fig. 3. Apparatus used in treating ruptured or divided tendo Achilles.
This apparatus is also used in the treatment of popliteal aneurism by flexion. In this latter case the bandaging of the calf of the leg is omitted.

Figs. 4, 5, and 6, exhibit the deformity termed talipes equinus, and Mr. Liston's apparatus used after division of the tendo Achilles.

Figs. 7 and 8. Two views of a child's foot affected with talipes varus.

Fig. 9. Operation of subcutaneous division of the tendo Achilles.

Fig. 10. Talipes valgus. The foot lies nearly in the position in which it does in Pott's fracture.

Figs. 11, 12, 13, and 14, exhibit the foot-piece recommended for the treatment of varus or valgus, as seen from the plantar aspect.

HÆMOSTATICS—EFFECTS OF LIGATURE.—

Plate XXI.—Page 400.

(From nature, by John Wintour.)

Fig. 1. Right common carotid artery of a dog, forty-eight hours after the application of a small round ligature. The artery and vagus nerve are imbedded in a mass of plastic exudation. A portion of this has been dissected off at one part, to show a deeper layer of plastic material adherent to the external surface of the artery, and covering in the ligature.

Fig. 2. The same artery opened. This exhibits the relations of the changes induced by the ligature on interior and exterior of the vessel. The section of the deligated point shows the circle of the ligature imbedded in lymph. Above and below this the divided coats are seen to be united by plastic matter. On the proximal side of the ligature a considerable blood-clot has formed ; on the distal side two small decolorised clots. The relations and attachments of the deep layer of the external exudation are well shown. The section shows the lymph to be closely adherent to the exterior of the artery forming a continuous layer from below to above the deligated point and bulging into the hollow formed by the constriction of the ligature.

Fig. 3. Appearances presented ninety-six hours after application of the ligature. The mass of plastic material on the exterior of the vessel is diminished in bulk, but firmer and more highly organised than in the Figures 1 and 2.

Fig. 4. Same artery opened. A very large blood-clot is seen on the proximal side of the ligature ; a smaller conical clot on the distal. The point of the vessel embraced by the ligature is beginning to undergo destructive changes ; it has a contracted and withered appearance. The deep layer of the external lymph has assumed a firm filamentous or membranous structure, and is seen connecting the ends of the vessel above and below the point of deligation.

Fig. 5. Carotid artery of a dog nine days after the application of the ligature, which was in the act of separating. The external plastic exudation was firmly consolidated around the artery, projecting into the groove formed by the ligature, and filling up the space from which the thread had passed, thus commencing re-union of the divided ends of the vessel. The knot of the ligature was contained in a cup-like cavity or cyst of lymph, and its ends were enveloped in a tubular prolongation of lymph, extending from the vessel to the external wound.

Fig. 6. Section of the same artery, exhibiting the relations and connections of the external and internal plastic exudation and of the clots. The ligature had just separated, and was lying loose in

the little cup-like cavity formed by the lymph. The lymph immediately around the knot was somewhat softer than the rest, but there was no appearance of purulent matter. The external exudation had followed in the track of the ligature, filled up the parts it had divided, come in contact with the internal plastic lymph, and thus the divided ends of the artery were re-united. The blood-clots were only firmly adherent at their bases.

Fig. 7. Artery thirteen days after the separation of the ligature. The point which had been tied is seen enveloped by a firm mass of consolidated lymph, which has united the separated ends of the vessel.

Fig. 8. Section of the same artery. Exhibits the connections and structure of the plastic exudation at the seat of ligature. There were no clots on either side of the deligated point in this case. The section of the consolidated lymph shows that the external and internal plastic exudations have coalesced so as to form a firm uniting structure of a fibrous character, and possessing a considerable amount of elasticity, as was proved by stretching the vessel.

Plate XXII.—Page 432.

(From nature, by John Wintour.)

Fig. 1. Carotid artery of a large dog, sixty hours after deligation. The coats of the artery and the ligature are seen imbedded in plastic lymph. The vessels having been injected with coloured size, the external plastic mass is seen to be highly vascularised even at that early period.

Fig. 2. The same artery opened, to show the internal changes and their relation to the external lymph. (See page 431.)

Fig. 3 exhibits a partial section of a carotid artery twelve days after deligation ; the ligature had separated four days previously. On clearing the artery from the surrounding parts, and making a section of the lymph connecting the ends of the artery, and also of the distal portion of the vessel, so as to show the relations of the external and internal changes induced by the ligature, the arterial parietes were seen covered with a network of minute vessels. The section of the lymp, between the divided ends of the vessel, exhibited a vessel of considerable size passing upwards through its centre into the internal plastic lymph, and also into the base of the blood-clot. (See page 434.)

Figs. 4 and 5. The carotid artery of a dog. The ligature had separated without any hæmorrhage. The external appearances, as shown in Fig. 4, presented the usual appearances of solid exudation round the deligated part of the vessel. On making a section of the vessel and plastic lymph, the appearances delineated in Fig. 5 were seen. On the proximal side of the ligatured part the internal adhesions had given way, and the blood-clot was partially extruded from the canal ; but the mass of consolidated lymph had prevented its further displacement, and so obviated secondary hæmorrhage. (See page 432.)

Fig. 6. Section of the femoral artery of a large dog, seventeen days after the ligature had been applied, showing the relation between the internal plastic coagulum and the blood-clot, as described at page 428.

Plate XXIII.—Page 443.

Fig. 1. Femoral artery, eight weeks after amputation. The stump had healed. There is no vestige of a clot. The artery is diminished in calibre at the point of ligature, and a mass of consolidated lymph is seen surrounding and occluding its extremity. (From nature, by John Wintour.)

Fig. 2. Femoral artery, seven weeks after amputation. Its section shows a large blood-clot firmly adherent to the coats of the vessel. (From nature, by John Wintour.)

Fig. 3. Carotid artery of a greyhound, injected minutely, dissected twelve weeks after ligature. Shows the vascularity of the fibrous cord uniting the divided ends of the vessel, and also the true relation and connections of what are sometimes supposed to be new vessels. (See page 440. From nature, by John Wintour.)

Figs. 4 and 5 exhibit the effects produced by torsion by Amussat's method (from Manec).

Fig. 6. The effects of accidental torsion on the brachial artery. The internal tunics are seen retracted and puckered inwards. The external coat is torn and twisted, and infiltrated with blood ; whilst immediately below the retracted internal coats a large blood-clot has formed. (See page 402. From nature, by Mr. Livesay.)

Fig. 7. Brachial artery from a stump, thirty-eight hours after the application of acupressure. The preparation is alluded to and described at page 445. The coats of the artery below the point where the needle had been applied are everted and thickened. Above, the interior exhibits a delicate and slightly adherent blood-clot. From the base of the blood-clot downwards the canal of the artery was plugged with firmly adherent lymph. The coats of the vessel have been opened and separated at one point to show the lymph filling up the vessel. The coats presented no appearance of injury by the needle. (From nature, by Mr. Abercromby.)

Plate XXIV.—Page 454.

Fig. 1. Sacculated popliteal aneurism after ligature. The sac, which projected forward towards the femur, is seen filled with strata of consolidated coagula. The patient died of delirium tremens about five weeks after the operation. (From nature, by Mr. Livesay.)

Fig. 2. Saccular aneurism of the innominate artery, showing the natural curative process. The sac is filled with strata of coagula, consolidated except at one part corresponding to the origin of the vessel from the aorta. At this point the disturbing force of the cardiac circulation has prevented the consolidation of the blood. A section of the wall of the aorta has been made to show the origin of the aneurism fully. (Mr. Livesay.)

Fig. 3. Dissecting aneurism. A rent of the internal tunics is seen in the ascending aorta, which is dilated just below the origin of the innominata. The blood has been propelled through this so as to dissect the coats from each other upwards along the innominate and also along the descending aorta.

Fig. 4. Fusiform aneurism of the axillary artery. This is a specimen of the "true aneurism of Scarpa," formed by dilatation of all the arterial tunics at the affected part.

Fig. 5. Dissecting aneurism of the common iliac artery. This occurred in a patient affected with senile gangrene. The vessels of the lower extremity were obstructed, as seen in the sketch; and, under an excited state of the circulation, the blood seems to have been forced backwards, so as to dissect the internal tunics from the external coat in a direction towards the heart.

Plate XXV.—Page 464.

Figures 1 and 2 exhibit the operation for False Aneurism at the bend of the arm, as described at pp. 464-5.

Fig. 1 shows the tourniquet applied to control the circulation, and the first incision through the integuments and superficial fascia. The deep fascia, distended by coagula, is seen bulging forwards in the wound.

Fig. 2. Wound after the clots have been cleared out. The opening in the artery is shown, with the ligatures placed one above the other, below the wounded point.

Fig. 3. Appearance of the thigh of Mr. K——, 14 months after the operation for traumatic varicose aneurism. The small white cross marks the cicatrix of the original wound, and to the inner side the long cicatrix of the operation-wound is seen, marked by dilated superficial veins; these are somewhat exaggerated in the sketch to make them distinct. See Clinical Cases.

Plate XXVI.—Page 459.

Fig. 1. Sketch of a case of femoral aneurism at the upper part of Hunter's canal, cured by ligature of the superficial femoral artery.—Case of W—— W——; see Clinical Cases of Aneurism.

Figures 2, 3, 4, and 5, exhibit different forms of apparatus for the treatment of aneurism by compression.

Fig. 2. Carte's compressor, used to compress the common, femoral, or external iliac arteries. In the apparatus shown, the ordinary compressing pad has been removed, and a rounded leaden weight substituted.

Fig. 3. Carte's compressor for the femoral in the thigh.

Fig. 4. Hoey's compressor.

Fig. 5. Compressor used successfully by Dr. Watson in three cases of aneurism. The apparatus consists of a splint, to which is attached a jointed and hinged metallic arc, provided with universal joint for supporting and directing the metallic rod, upon which slides the leaden elliptical weight by which the compression of the main trunk is effected.—*Edin. Med. Journal*, May 1869.

LECTURES ON SURGERY.

LECTURE I.

Inflammation—Its Cardinal Symptoms and their Etiology—Sketch of the Inflammatory Process in the Conjunctiva, Iris, Lung, Pleura, Synovial Membranes—The Textural Changes to which it leads — Its Constitutional Manifestations as exhibited in Symptomatic and Irritative Fever—Brief account of the composition of the Blood and the Functions of the Circulation in healthy and diseased Action—Nature and Origin of the Inflammatory Infiltration.

GENTLEMEN—In commencing an exposition of the Principles and Practice of Surgery, the first form of diseased action which we require to investigate is Inflammation, as, in one form or other, it complicates and modifies most diseases and operations. The term inflammation is purely conventional, and is originally derived from certain sensations and appearances, such as the feeling of burning heat and the bright redness present in inflammations of the surface. It is employed to denote a diseased action consisting of a series of phenomena, and indicated by certain objective and subjective signs which are termed the cardinal symptoms of inflammation.

The local symptoms are REDNESS, HEAT, SWELLING, and PAIN. These are attended by febrile constitutional disturbance and impairment of function in the part affected. Whilst no one of these conditions would by itself be a sufficient indication, yet the co-existence of them all would fully warrant us in pronouncing the part to be inflamed.

If we observe the phenomena of acute inflammation in a superficial part, we notice that the redness, which at first is comparatively slight and disappears on pressure, gradually becomes more persistent and of a deeper crimson tinge. The swelling, in the early stage, is uniform and soft, but as the diseased action goes on, it likewise changes its character, becomes firm and unyielding to the touch, and gives rise to tension at the affected part. At the same time the neighbouring parts are soft, swollen, and pit on pressure. The Redness and Swelling are termed the objective symptoms, and they are easily explicable as regards their more immediate causes. The former is obviously due to an increased determination of blood to the part, causing distension and greater activity of its capillary circulation, and constituting what

is termed the stage of active congestion. That the vessels of the inflamed part are enlarged, as compared with the same vessels in their normal state, has been repeatedly shown by direct experiments, and more especially by those of Sir James Paget. But we can observe it for ourselves in acute inflammatory affections of the eye, the structures of which are so transparent that we can readily trace the vascular changes. Thus in conjunctivitis we find the membrane, which in its natural condition is pale and colourless, with no visible bloodvessels, becoming injected and covered with large tortuous vessels (fig. 1, plate i.) If the diseased action continue, this, the stage of active congestion, gives place to the stage of passive congestion. The capillaries so affected seem gradually, either from mere over-distension or from affection of the vasomotor nerves, to lose their power of tonic contraction, until at last complete stasis is the result. In the inflamed conjunctiva we can see this vascular distension increase to such an extent that the individual vessels are almost entirely lost in the uniform red colour. This congested and swollen condition, corresponding to the stage of passive congestion and infiltration of tissue, constitutes chemosis.

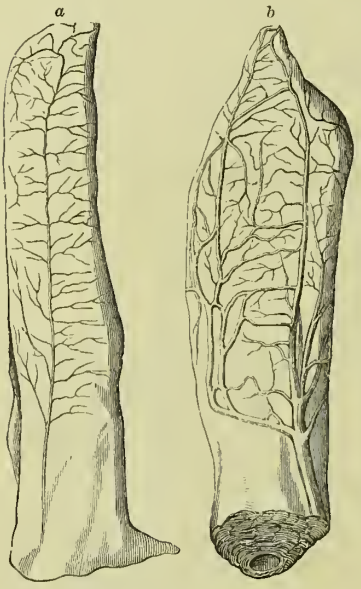

Fig. 1.

As the active congestion proceeds and passive congestion begins, the true inflammatory swelling and tension become more and more marked. This swelling, whilst it may be said to depend partly on the increased determination of blood to the affected part, is mainly due to certain changes taking place in the extra-vascular spaces from the effects of the altered state of the circulation. The hard, tense swelling results from what is termed inflammatory infiltration of the extra-vascular connective tissue of the inflamed part. The softer swelling of the neighbouring parts is due to serous effusion from larger distended vessels into the cellular tissue, constituting acute or inflammatory œdema. I shall say nothing at present regarding the intimate nature or supposed origin of the inflammatory infiltration, but confine myself to changes which can be observed by the unaided senses.

The phenomenon of swelling depending on the presence of inflammatory infiltration or plastic lymph, as it formerly was termed, in the tissue of an inflamed part, is undoubtedly the most important phase of inflammation. It is this which constitutes the distinction between mere excited action on the one hand and disease or the commencement of organic change on the other. We therefore require to note carefully

Fig. 1. The ears of a rabbit—*a*, healthy; *b*, the inflammatory process commencing, showing the dilated state of the vessels, and increased size of the part.—Paget.

Fig 1

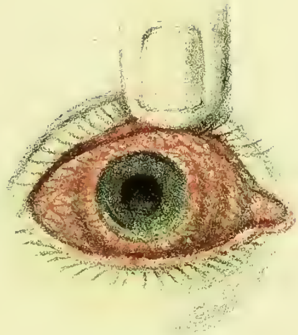

Fig: 2.

Fig 3

Fig 4

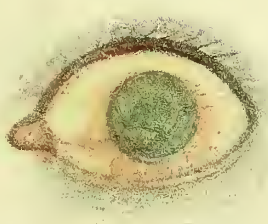

Fig 5

the structural changes which result from its presence. In the inflammatory chemosis of the conjunctiva, whilst a considerable part of the turgidity of the membrane is due to serous effusion or acute œdema, we have other portions firm from the presence of more plastic infiltration. In a case of deeper inflammation of the eye, however, if the cornea become affected no vascularity of the structure takes place, as the cornea contains no bloodvessels in its intimate structure, but the inflammatory infiltration derived from the capillaries at the margin of the cornea gradually permeates the corneal substance and occupies the branching spaces, until at last opacity is produced (figs. 2 and 5, plate i.) Again, in certain cases of iritis lymph is seen deposited on the iris in mass, as shown in fig. 4, plate i.; and this frequently leads to adhesions of the pupillary margin or partial or complete obliteration of the pupil by the formation of false membrane. We can thus see how this part of the inflammatory process leads to organic changes and interference with the normal functions. This will be dealt with more fully hereafter.

The phenomena of Heat and Pain, being sensations on the part of the patient, are termed the subjective symptoms. As regards the heat of an inflamed part, we can generally detect some increase of temperature by touch or by the aid of the thermometer, but such increase is seldom proportionate to the burning heat felt by the patient at the part. The heat is apparently due to the excess of arterial blood in the part, to the oxidation of texture, and to the increased rapidity of the molecular changes. The pain is generally considered to depend on the pressure upon and the irritation of the nerves of the inflamed part, by the distension of vessels and the swelling caused by the plastic infiltration into the tissues. Moreover, the sensibility to pain is probably increased or exalted by the general febrile tension of the system.

You will notice that the phenomena observed follow in regular sequence, and that the later changes are dependent upon those which precede them. Thus there is first the stage of vascular excitement leading to determination of blood to the part, distension of vessels, and at the same time increased activity. This constitutes Active congestion, and is soon followed by the over-distension of and loss of tone or power in the capillaries, leading in the end to complete stagnation of the circulation in them. This constitutes Passive congestion and Stasis. Further, especially during the latter state of the capillaries, part of the vascular contents escapes into the extra-vascular tissue and constitutes the Inflammatory infiltration. It is important to bear in mind the relation of these different parts of the diseased action to each other in reference to treatment.

I have directed your attention to the phenomena as we observe them in inflammatory conditions of the eye, but we have also means of diagnosing inflammations of internal organs which are hidden from view, and where of course the local appearances are not available. Here the symptoms are in great part due to impairment of function, and are readily referable to progressive morbid alteration of the organ affected. Let us take Acute Pneumonia, or Inflammation of the Lung, as an example, and let us first trace the pathological changes which it undergoes, and then the relation which these have to the symptoms. The

affected lobe when examined is found to be congested; its vessels are engorged with blood, and when we cut into its substance a quantity of blood and bloody serum mixed with air exudes upon pressure. In this state the lung still retains its elasticity, is crepitant, and will float in water. At other parts, however, where the diseased action is at its maximum, there is a distinct alteration in the pulmonary structure. It is no longer elastic and crepitant, but firm and solid. On section the surface is granular, red, and somewhat mottled, and you cannot press blood from it to any extent. This constitutes Red Hepatisation, or the "ramollissment rouge" of Andral. Further, it has lost its cohesion and is friable, and a portion of it when dropped into water sinks to the bottom at once, showing that the air-cells are no longer permeable to air but filled with solid inflammatory infiltration. Such a piece of lung substance is said to be Hepatised, from its resemblance in consistence to a piece of liver. The diagnostic symptoms are easily connected with these pathological appearances. First there is pain and oppression of breathing, and these we can readily understand arise from the congestion and acute œdema. At the same time, we find on auscultation over the affected part, that the respiratory murmur is no longer natural but accompanied by a peculiar fine crackling noise called crepitation. When we apply the stethoscope over the hepatised portion of lung, however, where the air-cells are occluded by the consolidated inflammatory infiltration, silence prevails—neither respiratory murmur nor crepitation can be heard, and on percussion we elicit a perfectly dull note. Beyond this dull area we notice that the crepitating sound is extending, and by and bye here also the respiratory sounds will cease as hepatisation sets in.

The changes of structure resulting from the effusion of the inflammatory product are also well seen in the alterations which take place on the free smooth surfaces of shut sacs such as serous and synovial membranes. Thus on the surface of the pleura, in the early stage, we see that membrane roughened by the deposit of granular or larger masses of lymph—a condition which accounts for the peculiar friction sound heard during respiration when the surfaces of the pleura costalis and pulmonalis move upon each other. In synovitis changes somewhat similar to these give rise to the friction or creaking sound which can be heard or felt on movements of a joint before the effusion of serum has become excessive. In other cases we have the opposed surfaces of the serous sac adherent by short soft masses of the new material, and after a time we find these becoming filamentous and membranous in appearance—elongating, and again permitting the natural movements to be resumed. We may recognise these after the lapse of many years, and they constitute the "Old Adhesions" resulting from inflammation. Should the serous effusion be excessive, the cavity of the sac becomes distended with the fluid, and we have dulness on percussion.

When mucous or cutaneous surfaces are affected, the inflammatory infiltration, whilst it effects changes in the structure immediately implicated, most frequently leads to permanent change by infiltration into the submucous or subcutaneous connective tissue. Thus in mucous canals the coating of the free surface by inflammatory deposit is com-

paratively rare, except in those forms of inflammation which are termed croupous. Stricture, or the contraction of the natural calibre of the canal, most commonly results from consolidation of and white fibrous formation in the submucous cellular tissue.

Pulpiness or softening of texture from molecular disintegration is another variety of structural change which may succeed inflammatory action, and this is seen more especially in the brain and nerves, in muscular tissue, and occasionally, though less frequently, in the skin, unless we include the softening which immediately precedes ulceration. In the latter case, however, we shall find hereafter that the skin is affected secondarily.

I have already stated generally that the local inflammatory changes are accompanied by more or less constitutional disturbance of a febrile character—the INFLAMMATORY or SYMPTOMATIC FEVER. The patient, as this sets in, feels chilly or has a rigor followed by febrile heat. The skin becomes hot and dry, the ordinary cutaneous transpiration being for the time arrested. The other excretions are also diminished, for we find that the urine is scanty and high coloured, and the bowels constipated, except when the mucous membrane of the intestine itself is inflamed. The tongue is generally milky white, but gradually becomes foul and furred; and if we examine the state of the pulse we find that it is excited, full, and incompressible, or small, hard, and wiry, and ranges from 98 to 120. There is great restlessness, headache, and intolerance of light, and occasionally delirium towards night. In short, we have all the symptoms of great febrile tension, with diminished excretion and consequent disturbance of the general vital functions. The severity of the fever varies in degree according to the extent of the local inflammation and the importance of the affected structure in the animal economy. The character or type of the fever may also vary, as when inflammation is excited in a weak or debilitated constitution. In such a case the symptoms will be those of IRRITATIVE FEVER. At first the symptoms are similar to those of inflammatory fever—viz. the hot dry skin, diminished excretion, and excited circulation. The pulse, however, although quick is weak and compressible, and the tongue, at first foul and red at the edges, has a tendency to become dry and brown. There is an anxious expression of countenance and low delirium, and as the fever proceeds typhoid symptoms gradually supervene, thus showing its asthenic character.

Having traced the progress of the phenomena of inflammation in its clinical aspect, and as it can be observed by the unaided senses, I will now direct your attention to the causes of inflammation and to some of the theories of the phenomena. This I shall do as briefly as possible, as it more properly belongs to the department of General Pathology. The remote causes of inflammation are either predisposing or exciting. The first includes epidemic and endemic influences, and certain conditions of the constitution, as scrofula, plethora, and exhaustion. The more obvious exciting causes are direct irritants applied to tissue, such as wounds, acids, or strong alkalies; stings of insects; presence of foreign bodies, as particles of sand or dust applied to the conjunctiva; extreme heat or cold. Cold may act either as a direct source of irrita-

tion, as we see in its effects upon the Schneiderian membrane of the nose and on the mucous lining of the air-passages, or the inflammation may follow reaction secondarily, as in some cases of frost-bite.

The causes proximately affecting the circulation in the inflamed part, and leading to the phenomena I have described, are more occult in their character. The theories advanced are numerous. It may be, as some have maintained, that some alteration in the extravascular connective tissue is the first link in the chain of diseased action, and leads to perversion of the circulation and of the nutrition of the part. Others have supposed that all the changes must be ascribed to the effect of the irritant upon the ultimate tissues. According to some, the vital activity of the tissues is diminished; according to others, it is increased, but at the same time perverted. Professor Bennett asserts that in inflammation the power of selection possessed by the tissues is lowered, whilst their power of attraction is so increased that they attract the liquor sanguinis itself from the vessels, and in this way we get the inflammatory infiltration. From what we now know of the effects produced on the capillary circulation by the sympathetic or vaso-motor nerves, it may be that Dr. Macartney's theory is not far from the truth. He supposed that a sense of irritation in the organic nerves of the part leads to the excitement of its capillary circulation and the subsequent phenomena.

Before I speak of the minute changes induced in the nutrition of the affected part, it is necessary, for the sake of the junior student, that I allude very briefly to the functions of the capillary circulation in healthy nutrition. The blood is composed of two portions, one fluid—the liquor sanguinis, consisting of fibrin and serum; the other solid—the blood discs or corpuscles, of which there are two kinds, the yellow and the white. If we examine a transparent membrane, such as the bat's wing or the web of the frog's foot, by means of a microscope, we see the blood flowing through the capillaries and smaller arteries and veins; we see that the yellow corpuscles move rapidly along the central or axial part of the vessel, whilst on either side and close to its walls is a clear space filled with liquor sanguinis, with here and there white corpuscles moving much more slowly than the yellow corpuscles do. This is termed the lymph space, and here the blood flows more slowly. The fluid part of the blood is that chiefly concerned in nutrition. It contains in solution the nutritive elements, and is imperceptibly attracted and assimilated by the various textures. Nutrition is carried on entirely in the spaces between the capillaries. These vessels consist of a single thin coat, through which the nutritive material can easily pass, and every tissue possesses an inherent power of attracting and selecting from the blood those materials best suited for its own nutrition. Bone selects more phosphates from the blood than other textures; the liver selects materials to form bile, and the kidney those to form urine. This power, exerted by all the textures, is a very important one in maintaining the circulation. By it arterial blood is attracted towards the tissues, and hence it is termed the *vis a fronte*, in contradistinction to the power exerted by the heart and the elastic coats of the arteries, which is called the *vis a tergo*. To an excited attractive force of tissue is due the local

determination of blood which occurs in inflammation. When we irritate the web of the frog's foot by some stimulus, such as a drop of acetic acid or a little mustard, inflammation is gradually induced, and we can observe under the microscope the changes which take place. The vessels at first contract, and the current of blood through them is more rapid. They then gradually dilate, but the current still passes through them more rapidly than in the normal state, because the *vis a fronte* is increased by the irritation. The blood therefore now flows in larger quantity and with increased rapidity, constituting what is known as *determination of blood to the part.* This is the stage of *active congestion.* It corresponds to that condition of the inflamed eye characterised by florid vascular arborescence. The vessels continue dilated, but the blood soon begins to flow with diminished rapidity; it then moves to and fro —that is, it oscillates; and finally it comes to a complete standstill— stagnation or stasis. This is the stage of *passive congestion.* In the normal state of the circulation we can distinguish the individual corpuscles in the moving blood, but when complete stasis occurs their outlines can no longer be recognised, and the capillaries are filled with a semi-fluid gelatinous red mass. To explain this stasis Boerhaave advanced his famous "error loci" theory—a very erroneous theory indeed, seeing that it is founded upon the fallacious anatomical doctrine that there are three different sizes of corpuscles, and three different sets of capillaries to suit. He inferred that in the normal state of affairs the small corpuscles passed through the small capillaries, and the large corpuscles through capillaries of corresponding size. The stagnation he supposed to be due to a large corpuscle passing by mistake into a small vessel, blocking it up, and so producing obstruction. Cullen tried to explain the stagnation as due to a supposed "spasm of the extreme vessels leading to irregular circulation." Sir Charles Bell pointed out that whatever either irritated or impaired the vitality of the vascular wall tended to arrest the flow of blood even in the larger vessels. Hence in the irritated condition of the extra-vascular tissue we find a ready explanation of the phenomena of stasis. Soon after stagnation has taken place the inter-vascular spaces become clouded with the inflammatory infiltration. These changes may be all seen in the field of the microscope at one time as concurrent phenomena, but I believe that they follow in regular sequence—each resulting from the one that preceded it.

The nature and origin of the inflammatory infiltration has led to much discussion, and the theories advanced in explanation have been both numerous and conflicting. Professor Bennett believes that it arises from the exudation of liquor sanguinis from the engorged vessels, and that this constitutes an amorphous blastema in which new vital structures are spontaneously developed by the precipitation and cohesion of molecules. These structures differ according to the tissue into or upon which the exudation is thrown out. He emphatically denies that any corpuscle—either red or white—can escape from a vessel unless the wall of that vessel be injured. Redfern and Virchow, on the other hand, after observing the changes which take place in cartilage and in the cornea when artificially inflamed, have endeavoured to prove

that the inflammatory infiltration results from the rapid and extensive proliferation of the tissue-cells. The most startling and perhaps the most generally accepted view of the matter is that promulgated by Cohnheim. He holds that it is due to the migration or bodily passage of the white corpuscles from the vessels into the extra-vascular spaces. This feat they accomplish by means of their own amœboid activity. They shoot out protoplasmic processes, which extend themselves through certain apertures or stomata which he believes to exist between the cells forming the capillary wall. Others, however, consider the capillary wall to be composed of protoplasm, and in this way they account for its ready penetration by the corpuscle and its subsequent closure after the passage is completed. Lastly, Stricker has lately maintained that the infiltration is dependent partly upon cell-migration and cell-proliferation or segmentation—this view being intermediate between that of Virchow and Cohnheim.

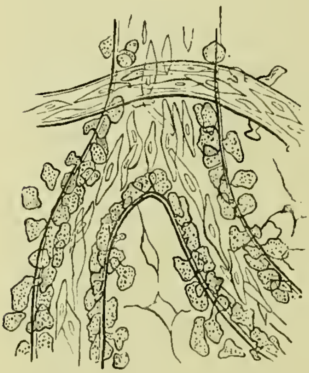

Fig. 2.

Fig. 2. Showing the passage of blood corpuscles through the vascular walls.—(From Caton, see *Journal of Anatomy and Physiology*, vol. v. 1871.)

LECTURE II.

Inflammation, continued—Its Classification into Acute, Subacute, and Chronic—Characters of Chronic Inflammation—The Terminations of Inflammation—Treatment of Acute Inflammation—General Indications—The necessity for the removal of all Sources of Irritation—Uses of Anodyne Fomentations and Hot and Cold Applications—Direct Depletion—Indirect Depletion, and the Arguments *pro* and *con*—Restoration of the Excretions by Diaphoretics, Diuretics, Purgatives—Deobstruents and Counter-irritation—Diet to be observed—Treatment of Chronic Inflammation.

Inflammation may be acute or chronic. In the acute the disease runs its course more rapidly and with greater violence than in the chronic form. Acute inflammation may become chronic, and the chronic may become acute, or I would rather say subacute.

Chronic Inflammatory Action.—When inflammation is chronic the symptoms are negative rather than positive; there is no violent action; the vascularity is but little marked; there is uneasiness rather than positive pain. The rise in the pulse is but slight, and the constitutional disturbance is not so marked as in acute inflammation. In chronic inflammation of certain important organs febrile symptoms are present, more especially at night. There is a feeling of lassitude, the palms of the hands are hot, and the patient complains of slight headache or uneasiness. Then ensue restlessness at night, and perspiration towards the morning. The pulse is more rapid in the morning and in the evening than throughout the day. We must bear in mind, however, that, notwithstanding the mildness of the symptoms as compared with those of acute inflammation, important alterations in structure are taking place insidiously, and we must therefore not be deceived by the apparent innocence of the malady.

The Terminations of inflammation are various. It may end in Resolution, and this is the most favourable termination, and that which we always endeavour to obtain. In this case the increased vascularity, pain, and tension disappear, the exudation becomes absorbed, and the part returns to its natural condition or nearly so. This may be seen in many cases of conjunctivitis when actively treated, and may also be studied in cases of orchitis or inflamed testicle. On the other hand, inflammation may be less favourable in its ending, and lead to fibrous formation, pulpiness, or friability or consolidation of texture. The first is a very common result of inflammation of serous and synovial membranes, and it is likewise sometimes met with in the case of mucous canals, where it gives rise to thickening and produces stricture of the passage, as in the urethra, rectum, and œsophagus. We have already

mentioned that pulpiness may follow inflammation of nervous or muscular tissue, and that consolidation and friability may result from inflammation of the lung. Sometimes, on the termination of inflammatory action in one part, it reappears in another: this is termed Metastasis, and is sometimes seen in Erysipelas, where the inflammation may cease in the skin—the part originally affected—and reappear in a mucous membrane or elsewhere. It is merely a change of the disease from one place to another, and therefore cannot be considered a termination of inflammation. Lastly, the inflammatory process may go on to suppuration, ulceration, or gangrene or sloughing—results which will be considered in their proper place.

We now proceed to discuss the *Treatment* of acute inflammation with the view of procuring *resolution.* The General Indications are—1*st*, To remove the cause; 2*d*, To moderate excessive vascular action, and to relieve the congested capillaries; 3*d*, To restore such natural excretions as have either been diminished or altogether arrested; 4*th*, To produce disintegration and absorption of the exudation; and lastly, in certain cases, more especially of chronic inflammation, to create metastasis, by exciting inflammation in a less important part.

If any foreign body, or other source of irritation, be present, it must be removed at once, for even though its removal may not altogether arrest the diseased action, its presence tends to keep it up, and will prevent its successful treatment.

Vascular action may be diminished by lessening the irritation which gives rise to it. This may be done by giving opiates internally, or by anodyne fomentations. Hot or cold applications are frequently used. In regard to the application of heat or cold in local inflammations, you may very naturally ask what rules are to guide you in prescribing such apparently opposite remedies; and, in point of fact, the answer is not quite so easy to give in words as might be expected from the familiar way in which we speak of those remedies. I believe that the choice of hot or cold applications is a matter of tact and experience. It is true we try to explain their *modus operandi* by saying that cold allays irritation of the part, and moderates excessive vascular action by causing vital contraction of the vessels, thus limiting inflammation to the minimum; and that heat acts by soothing the nerves and relaxing the vessels and tissues, so that the vessels more easily relieve themselves by effusion. But the great question is, In what conditions does the one or other of these remedies act beneficially? What are the indications which lead the surgeon to prescribe at one time cold and at another time heat? My own experience leads me to believe that the benefit of cold applications is limited to a comparatively short period of the inflammatory process—viz. excited action, and perhaps active congestion of a part, and that they are especially beneficial in so far that they prevent or modify the subsequent phenomena. Heat, on the other hand, in the form of tepid applications, such as lint dipped in lukewarm water and frequently renewed, answers better, and is more soothing when inflammation is fully established; and I have especially noticed this in great wounds, in which, if cold be continued beyond six or eight hours, uneasiness, increased pain, and a low form of local inflammation,

are induced, whereas a change to tepid applications soothes, removes redness and swelling, and favours the healing process.

The relief of congested capillaries can be effected directly by local depletion or indirectly by diminishing the force of the heart, whilst we at the same time do what we can to allay local irritation. We can directly deplete some inflamed parts by making an incision into them. This incision, in addition to relieving the distended bloodvessels, permits the pent-up infiltration to escape and so diminishes tension. In other cases, instead of bleeding the inflamed part itself, we draw blood from a neighbouring part whose vessels communicate directly with it. In conjunctivitis, for example, if blood be taken from the anterior branch of the temporal artery, we find that the vessels of the conjunctiva are emptied, and the part begins, under the bleeding, to lose its vascularity and to assume its natural appearance.

By indirect depletion or bleeding from a vein or artery not directly connected with the inflamed part, we strive to relieve the diseased action by first affecting the system. It acts (1st), by diminishing the whole quantity of blood in the body, and therefore proportionately the amount of blood in the inflamed part; (2d), by depressing the heart's action, causing faintness, and thus reducing the *vis a tergo*; (3d), by determining the flow of blood to the opened vessel where the resistance to the circulation has been to a certain extent removed, and thus temporarily interrupting the determination of blood to the inflamed part. By this agency, therefore, the capillaries of the inflamed organ are so far emptied and congestion relieved. The beneficial effects of general depletion are well exemplified when venesection is employed in the earlier stages of pneumonia. The oppression of breathing disappears and the diseased action is either cut short or has its area limited, and all this is due to the draining away of the blood from the engorged pulmonary vessels.

Of late years it has been fashionable to decry the use of general blood-letting, and thus the foregoing statements may be considered by some very heterodox. I do not feel inclined, however, to withhold views which my own experience in the past—when bleeding was only too frequently resorted to—satisfies me are practically correct. The opponents to general depletion denounce the practice as being unscientific, and urge that it is so, (1st), because it is not in accordance with pathology, and (2d), because it diminishes the vital powers of the patient, and thus interferes with nature's efforts to overcome disease and restore healthy action. They ask us, "Can depletion remove the inflammatory infiltration which has taken place, and which constitutes the most formidable part of the diseased action?" Most decidedly not—and no one would suppose for a moment that it could do so directly; but by relieving the preceding phenomena of excited action and congestion it will tend to prevent further infiltration, organic change, and functional disorder, and thus leave less mischief to repair. I hold that general depletion is quite in accordance with the pathology of inflammation, so long as we view that action in its progress as a whole, and do not limit our ideas to one part or one result of the action. The second objection is in great part pure assertion, and what grain of truth there is in it is drawn from an experience in treating a class of

patients whose previous health or habits, or both, render them unfit to bear even moderate depletion, or patients who have been admitted into the hospital when the inflammation (say pneumonia) was far advanced and extensive. Surely the employment of venesection in improper cases is no good argument against its judicious use. As to the exaggerated pictures sometimes drawn of the slow and imperfect recoveries, the permanent debility, and the wasted and anæmic forms of the victims of blood-letting, I can only in charity suppose that they are sketched by those who have had no opportunity of seeing the practice they condemn, and who therefore draw largely on their imaginations to describe what they suppose should be the results. Although I have seen a good deal of the use, and also, I have no hesitation in saying, the abuse of the lancet, when venesection was practised indiscriminately, and when it was customary for people to be bled periodically as a preventive to disease, I cannot recall any of these fearful results; but I can remember many a case where relief from suffering was afforded and cure of acute disease effected by the prompt and judicious use of blood-letting. It should not be forgotten that the continuance of the intense febrile state, which is symptomatic of the local inflammation, is a far greater source of exhaustion of the vital powers than the timeous abstraction of a few ounces of blood.

From what I have said you will readily understand that I do not advocate an indiscriminate use of blood-letting in inflammation. The state of the patient's health prior to the inflammatory attack, the strength and character of the pulse, the stage of the disease, and the extent of the organ affected, must all be carefully considered. It is in the early congestive stage that it is most likely to prove serviceable, and then a moderate quantity of blood withdrawn will often produce the desired effect, and enable us by the subsequent use of depressants or counter-stimulants—remedies which lessen the force and frequency of the heart's action—to keep up the effect produced on the circulation, to prevent over-reaction, and diminish the general febrile tension of the system. The medicines used for this purpose are tartar-emetic either alone or with an opiate; or, when we are anxious to avoid nausea, small doses of aconite or digitalis.

When there is a hard and quick pulse, hot dry skin, scanty urine, and constipation, we must endeavour to restore and even to increase the excretions of the skin, kidney, and intestinal tract. To restore the cutaneous transpiration we have recourse to remedies termed diaphoretics, such as the eighth of a grain of tartar-emetic, combined with a quarter to half-a-grain of opium, every four hours. In certain cases tartar-emetic is contra-indicated, and the opiate, either given by itself, or combined with two grains of ipecacuan, may be substituted. The liquor ammoniæ acetatis is also useful as a stimulating diaphoretic. To act on the kidney we employ medicines termed diuretics. We must be cautious in the use of stimulating diuretics, lest we over-excite the kidney, and increase the congestion of that organ. Acetate of potass, in doses of ten grains, or small doses of sweet spirits of nitre, largely diluted, and simple cooling drinks, are our best remedies of this class. To stimulate the alvine excretion, and remove the constipation, we prescribe purga-

tives, which require to be varied according to circumstances. For example, in some cases we employ hydragogue cathartics to procure rapidly copious watery evacuations. In other cases, where there are biliary symptoms, the use of alterative purgatives, such as mercurials, is indicated. During the active stage of inflammation, with its concomitant fever, the patient's diet requires to be carefully regulated. Animal food should as a general rule be avoided, and the patient put upon a nutritious non-stimulating diet, consisting of milk and farinaceous food. Wine and all stimulants are contra-indicated in this stage, except under peculiar circumstances.

To procure disintegration and absorption of the exudation, we have recourse to what are termed deobstruent remedies. Among the more valuable of these are mercurials and iodine given internally, and tincture of iodine, blisters, and pressure, applied locally. The *modus operandi* of these remedies is obscure; but though we do not certainly know how they act, we use them because experience has shown their good effects. They seem to stimulate the part to action, and cause the exudation to be disintegrated, to re-enter the venous capillaries and be excreted. In cases of swollen testicle, for example, when acute action has entirely ceased, and where some induration exists, the application of iodine, or some stimulating preparation of ammonia, causes the swelling to disappear rapidly. This was formerly supposed to be due entirely to increased activity of the absorbents, but it is now believed that the remedy causes disintegration and elimination of the exudation. The application of a bandage in certain cases to a swollen part, and the introduction of a bougie, in cases of stricture, act as deobstruents by the pressure and consequent stimulation they produce. The action of internal remedies as deobstruents is still more difficult to explain, but the effect produced is often quite evident; for instance, in iritis, where there is effusion of lymph on the edges of the iris, when mercurials are given internally the lymph speedily disappears.

Another remedy employed is artificial metastasis or counter-irritation, the principle of which is to determine the diseased action to a less important part, and thereby relieve the organ originally affected. Thus, in inflammation of deep-seated bones and joints, the use of counter-irritation is often followed by marked relief. This mode of treatment is most beneficial in subacute or chronic inflammation. The principal counter-irritants used in surgery are blisters, rubefacients, setons, and the cautery.

In order to bring the treatment before you as a whole, let us take the example of inflammation of the eye, since we have already used it to illustrate the pathology. In the first stage of conjunctivitis we make use of cold applications, such as lint or rag soaked in cold water, and laid over the eye. When the active congestion is well marked, with passive congestion at some points, the acetate of lead and opium lotion, or a decoction of camomile and opium, is applied. We cannot, however, trust to these measures alone, so we deplete from the anterior branch of the temporal artery, from the angular vein of the eye, or by leeches, and then give small doses of tartar-emetic and opium, which keep down he excited action and also act as diaphoretics. These measures, con-

joined with the use of purgatives, are all that is required in most cases. Scarifications are sometimes employed, but they are apt to cause too much irritation. In the chronic state, blisters on the temple are very beneficial. In the further stages of the disease different treatment must be adopted. Should there be chemosis or projection of the swollen conjunctiva over the cornea, that membrane must be snipped to permit the serous and plastic infiltration to escape, lest by pressure it should interfere with the vitality of the cornea. Subsequently warm fomentations are applied, which may be changed after a little to tepid or cold dressings. In sclerotitis there is often a specific condition present—viz. rheumatism or syphilis—and this must be kept in mind in treating the disease. Here, as in conjunctivitis, we have recourse to depletion. We treat the specific condition by exhibiting colchicum or iodide of potassium. Cold local applications should be avoided. Alterative doses of mercury, followed by a saline, may often be given with advantage. In iritis, besides the general treatment already alluded to, we employ a specific remedy to prevent contraction of the pupil—viz. belladonna, or a solution of atropia in glycerine, rubbed over the eyebrow or around the eyelids. To get rid of the effused lymph we give mercurials, which act almost like a charm in causing it to disappear. In all cases of inflammation it is important that the inflamed part should be kept at rest, and thus, in the case of the eye, the organ should be protected from light and other sources of irritation. The diet and regimen must be strictly antiphlogistic.

In the Treatment of chronic inflammation depletion is contra-indicated: instead of lowering the circulation, our object is to stimulate it, both locally and generally. In chronic conjunctivitis, for example, we use stimulants and astringents, such as solutions of nitrate of silver, sulphate of copper, and sulphate of zinc, to get rid of the passive congestion. The use of blisters, or other form of counter-irritation, also the employment of deobstruent and alterative remedies, are specially indicated. To combat the low form of febrile action, and support the general strength, we have recourse to preparations of bark, chalybeate tonics, and generous diet.

LECTURE III.

Minor Operations connected with the Treatment of Inflammation—General and Local Blood-letting—Venesection—Reasons for choosing the Median Cephalic Vein—The Steps of the Operation described—The Closing of the Bleeding Orifice—Venesection of the External Jugular—Arteriotomy, where and how performed—Cupping and Leeching, their Relative Advantages—The Operation of Cupping described.

General depletion, or blood-letting, may be effected by opening either a vein or an artery, and these two modes are respectively named venesection and arteriotomy.

Venesection is the operation more generally practised; and the vein usually selected is one or other of those situated at the bend of the arm, or the external jugular. Of the veins at the bend of the arm, we prefer to open either the median basilic or the median cephalic, for these are not only larger in size, but are more fixed in position than are the lateral basilic and cephalic. If a vein be not fixed in its place it is liable to roll about under the skin; and should this displacement occur during the operation, blood would escape into the cellular tissue, and there become formed into a sanguineous tumour or thrombus. In selecting a vein on which to operate, it is also necessary to bear in mind its anatomical relations to the artery, otherwise both may be wounded. The median basilic vein overlies the brachial artery at the bend of the arm; and although more superficial, and separated from the artery by a strong aponeurosis, yet if the operation be performed carelessly, or if the patient give a sudden start, the lancet may penetrate the fascia and the artery beyond. For this reason, I generally prefer to open the median cephalic, it being separated from the line of the artery, and also being of a sufficient size to afford a good stream of blood.

Having decided on the vein to be opened, we first place a bandage, tied with a slip knot, round the arm, above the point where the opening is to be made. This serves to obstruct the current of blood returning to the heart, and causes the vein to distend. We then draw the thumb of the left hand upwards over the course of the vein, and press on it just below the part where it is to be opened. We next push the point of the lancet into the distended vein until resistance ceases, or until we see blood; then move the blade so as to make an oblique opening in the vein, and divide the skin more largely than the vessel. It is necessary that the wound be oblique; for if it be longitudinal the blood does not flow readily, and if transverse the vein may be cut completely across. The incision in the skin ought to be larger than the opening in the vein, otherwise some blood may find a lodgment under the skin,

and thus give rise to the condition termed thrombus, already alluded to. When the blood flows sluggishly, we desire the patient to move his fingers while grasping in his hand a piece of wood or other firm substance. This causes muscular compression of the deeper veins, and so produces in those more superficial an increased flow of blood. The amount of blood to be abstracted must be regulated by the effect produced on the circulation and the extent to which depletion is indicated. When we wish to stop the bleeding, the fillet must be removed; but, before doing so, the thumb should be placed on the bleeding orifice. Thereafter, the arm being placed in a bent position, a compress of lint should be applied to the wound, and retained in that position by means of a figure-of-8 bandage. The arm should then be supported in a sling.

Venesection of the external jugular is sometimes performed. It is had recourse to in certain cases of croup in young children, and apoplexy in adults, and often affords great relief. It is also useful in cases accompanied with venous congestion of the great vessels of the head or chest. The operation can be performed very readily, and the opening should be made at the point where the vein lies upon the sterno-mastoid muscle, for there it is more fixed and more superficial than at any other part of its course. The external jugular, however, is not quite superficial like the median cephalic and basilic veins. It is covered by the platysma-myoides muscle, and for this reason it must be opened in a different way from the veins at the bend of the arm. If opened by one cut in a line oblique to its own course, but parallel to the fibres of the platysma, these, by their contraction, would prevent a free exit to the blood, and thereby give rise to the danger of extravasation and thrombus. The opening in the skin should be made with the edge of the lancet obliquely to the course of the vein. The fibres of muscle should then be divided transversely before opening the vein, so that they, by retracting, may cause the wound to gape and thereby secure a wide external opening. The other steps of the operation are similar to those already described. The vein should be compressed by means of the finger or thumb above the clavicle, and below the point where you intend to enter the lancet. This is necessary in order not only to make the vein rise, but also to prevent the entrance of air into it, which circumstance, if it occurred, might be attended with a fatal result. The vein should then be opened obliquely as we have already indicated. When a sufficient quantity of blood has been withdrawn, the flow should be arrested by means of a pad of lint placed over the wound, and retained in that position by strips of adhesive plaster. These serve the purpose better than a circular bandage round the neck, as they are less liable to occasion congestion. In restless patients—as children—the pad may be retained in position by means of a bandage passing obliquely over the neck, and tied under the opposite armpit. Venesection of the jugular vein is popularly regarded as being a very formidable operation—people speak of opening the great jugular with feelings of dread. This is, however, unwarranted apprehension, for the bleeding is not more difficult to arrest here than in the arm.

Arteriotomy is now performed only on the anterior branch of the temporal artery, and chiefly for affections of the eye. The temporal

artery, though apparently superficial, is covered by a layer of dense fascia which prevents you from reaching the vessel so readily as you might expect. The arteries are not uniformly dilated as are the veins ; and as the vessel should be in a state of dilatation when the opening is made through its coats, we endeavour to attain this by compressing it on the distal side of the intended opening. When the vessel is thus distended, we cut down upon it with the edge of the lancet. Having thus laid it bare, we make an oblique opening into it with the point of the instrument. We must take care not to make a transverse opening, for by so doing we would very likely cut the artery completely through. An *unexhausted* cupping-glass may be placed over the opening for the sake of cleanliness, and to prevent spirting of the blood. Do not attempt to draw off the blood by means of an *exhausted* cupping-glass, for the edges of the glass would press on the artery, and thereby completely arrest the flow of blood. When we wish to arrest the flow, the artery should be cut completely through. Its coats will then contract and retract, and the bleeding will cease. A compress and bandage should be applied, the bandage twisted firmly over the pad and tied under the chin. Should there be any difficulty in arresting the flow of blood by compression, you should tie the cut ends of the vessel, or secure them by means of acupressure.

PUNCTURES, SCARIFICATIONS, and INCISIONS, are sometimes had recourse to as means of local depletion ; and if our object be simply to draw blood, without seeking to effect relief of tension, the incisions need not be made deeper than the skin ; but generally we make the incisions sufficiently deep to permit the escape of serum, or other effusions, so as to relieve tension of the parts affected.

CUPPING and LEECHING are other methods of blood-letting. Leeching is a favourite mode, but leeches cannot always be obtained, and, when obtainable, they have the disadvantage of being less certain in their action ; moreover, the flow of blood which follows their use is somewhat difficult to estimate or regulate. If, however, leeches are to be applied, the surface should first be well washed with warm water. When they drop off, a warm sponge should be held to the part to encourage the flow of blood. If the bleeding from a leech-bite threaten to be troublesome, it may be arrested by taking a small needle and transfixing the wound, then tying a thread round it.

CUPPING is the more convenient mode of depletion, and it is very beneficial in certain cases, such as acute affections of the joints.

The operation consists in placing an exhausted glass cup over a number of scarifications made by an instrument designed for the purpose. The scarificator consists of a metallic box, with slits corresponding to a dozen revolving lancets contained within it. These, when at rest, are concealed from view, but, on touching a spring on the side of the instrument, they are made to perform an instantaneous revolution, and, in doing so, each point projects for a certain distance through a narrow slit in the case ; and if the scarificator be placed against the surface of the body and the trigger pressed, each lancet makes a corresponding incision through the skin. Then a cupping glass, which resembles a small tumbler, is exhausted of air by means of a spirit-lamp,

and placed over these incisions, and the blood is rapidly drawn into it by means of suction.

Before the incisions are made the part should be well warmed, and an exhausted cup applied so as to determine the blood to the surface. The scarificator should then be "set" so as thereby to determine the depth of the scarifications. By placing the instrument at half-cock, you will at once see the length to which each point will project when in action, and you must be guided in adjusting them by the stoutness or leanness of your patient, and the part of the body on which you are to operate. Be careful to follow a middle course. Do not make the incisions too deep, lest you penetrate the cellular tissue, and so cause the blood to flow into it, nor too shallow, or but little blood will come, nor into the adipose tissue, or it will project through the openings and plug them.

After the incisions are made, the cupping-glass, previously heated, should be held over the scarified part, with the one edge resting on the skin and the other raised about an inch and a half from it. A spirit flame is then held for a second or two within the raised edge of the glass, and, when withdrawn, the glass pressed firmly on the skin, so as to prevent the entrance of cold air. The glass must not be exhausted too much, or the pressure exerted by the rim against the skin will prevent the blood from flowing towards the incisions.

The quantity of blood drawn must always be regulated by the circumstances of the individual case, and the degree to which the circulation is affected by the operation.

You have now to learn how to remove the glass when it is sufficiently filled, and this apparently simple proceeding requires the exercise of tact and neatness, otherwise the blood will be spilt, and cause unnecessary trouble.

You should place a folded towel just below the under edge of the glass. Then insinuate the nail of your forefinger beneath the upper edge of the glass to loosen it, while, with the other hand, you hold the lower part of its rim pressed against the skin, so that the blood necessarily falls into the cup without being spilt, being directed towards it by a sponge used by your free hand. After emptying the glass it can be re-applied, if necessary.

After sufficient blood has been drawn, the wounds should be closed with adhesive plaster.

But as all these operations can be more easily demonstrated than described, I shall now proceed to show you the different steps of the process on the dead body before us.

LECTURE IV.

Suppuration—Pus: its Nature, Varieties, Microscopic Appearances, and Chemical Constitution; its Origin—Superficial Suppuration—Abscess: Acute and Chronic; Circumscribed, Diffuse, and Infiltrated Abscess—Diagnosis and Treatment.

ONE of the most common results of inflammation is that termed SUPPURATION. A fluid is formed during this process to which the older surgeons gave the name of pus, because they imagined that it resulted from putrefaction of the textures implicated in the diseased action. Healthy or "laudable" pus is a bland and unirritating, pale yellow-coloured fluid of the consistency of cream, but somewhat more tenacious. It has a peculiar heavy, somewhat sickly odour, and, according to some curious investigators, it possesses a sweet, mawkish taste. A second form of pus is known as serous, curdy, flaky, or scrofulous. It is thin, like whey, and is mixed with flakes of broken-down lymph, or perhaps coagulated albumen; such pus indicates a low, weak condition of the system. It is generally found in chronic abscesses. A third form of pus is termed sanious, grumous, or bloody. It is thin, and of a brownish-red colour, and is generally secreted by irritable or unhealthy surfaces. A fourth variety of pus is termed ichor. This is a thin irritating fluid of a disagreeable odour. An example of it is seen in the discharge from malignant or specific sores, such as cancer.

Under the microscope pus is seen to consist of nucleated cells floating in a liquid termed the liquor puris (fig. 3). Each pus-cell is about the 1-3000th of an inch in diameter—globular and slightly irregular on the surface, like a mulberry. When acetic acid is added to it, the cell distends and the cell-wall becomes very transparent, while it brings into view the nucleus, which usually consists of three granules adhering the one to the other. Pus-cells closely resemble mucus corpuscles and the white-blood corpuscles. Chemically, pus consists of fat, albumen, globulin, and salts, and on heating, the albumen is coagulated. Its specific gravity varies from 1021 to 1041. A solution of caustic potash converts it into a thick, tenacious fluid. This agent may be used as a test to distinguish pus from mucus, for while it renders pus more tenacious it renders mucus more fluid.

Fig. 3.

The fluid portion of the pus, or the liquor puris, is derived directly or indirectly from the liquor sanguinis of the blood, but the origin of the pus-corpuscles is a disputed point. According to Dr. Bennett they

are formed, like most other morbid cells, by the precipitation and subsequent cohesion of molecules of the fibrin of the exudation. The most generally accepted view, however, is that they are derived partly from the blood and partly from the affected tissue. The white-blood cells, which we have seen are almost identical with pus-corpuscles, are supposed to penetrate the vascular walls and by multiplication to form pus-cells, whilst at the same time the cellular elements of the inflamed tissue proliferate either by fission or endogenous multiplication, and of the resulting cells a certain proportion also become pus-corpuscles.

The process of suppuration is either *superficial* or *interstitial:* the former occurs in a wounded or abraded surface, or in a mucous membrane even when its surface is entire, as seen in conjunctivitis and gonorrhœa. Interstitial suppuration takes place in the interior of organs, and gives rise to collections of pus termed abscesses.

Superficial Suppuration takes place in all wounds which do not heal by a rapid union of the cut surfaces—union by the first intention as it is called. The surface of the wound assumes a greyish or dirty-orange colour, the margins become purple and swollen, and a thin serous or viscid exudation appears on its surface. If the wound be large, inflammatory fever sets in. The margins of the wound become red, tense, and everted; the patient has a chill or rigor; and when this occurs, we infer that suppuration is about to take place. Then the edges become more everted, pus is formed and thrown off freely, the pain begins to abate, and the symptomatic fever declines. Though the surrounding skin still retains a slightly purplish colour, the tension, redness, and hardness, diminish. The symptomatic fever was formerly considered to be caused by pus circulating in the blood, and the relief to be due to its elimination. This idea, however, has been abandoned. The alleviation of the constitutional symptoms is due to the relief of the local congestion and tension.

In Interstitial Suppuration or Abscess the fever and rigor occur as in superficial suppuration, but when the pus has formed, no relief is obtained—the very reverse in fact, for here the purulent matter is confined, and gives rise to increased tension and pain. Abscess occurs in two forms—the *acute* and *chronic.* The acute form is divided into *circumscribed, diffused,* and *infiltrated.*

In Circumscribed Acute Abscess (plate ii. fig. 2) the ordinary symptoms of acute inflammation precede the suppuration. The pain and tension increase, inflammatory fever supervenes, the colour of the part changes first to a bright red and then to a purplish hue, and when the abscess is deeply situated there is acute œdema of the superimposed cellular tissue. The hardness increases from the exudation which is thrown out. Succeeding these symptoms we have a distinct chill or rigor, indicating incipient suppuration. In the centre or focus of the diseased action pus is now formed, and around this is a layer of condensed plastic material forming a hard boundary: this has been called the cyst of the abscess. As the suppuration goes on the lymph decreases in quantity and density. The purulent fluid, by its presence, causes absorption of the plastic matter, and tends to point towards one or other of the free surfaces of the body—the cutaneous or the mucous; gener-

SUPPURATION. Plate II

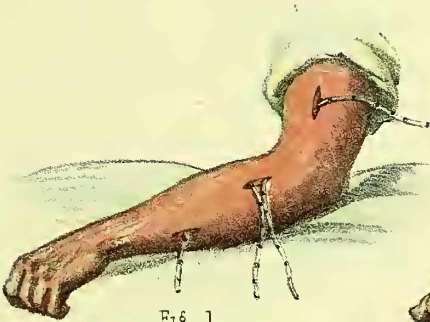
Fig. 1.


Fig. 2.


Fig. 3.

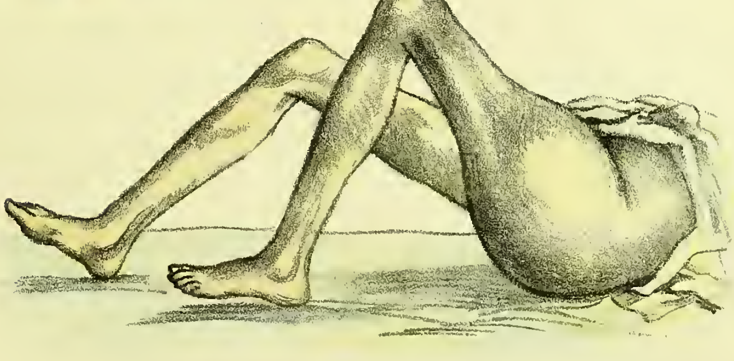
Fig. 4.

Waterston & Son Edin Lith

ally the former. If situated near the surface there is redness and swelling, with a hard resisting portion around the abscess.

If the abscess be left untouched it will at length burst, and the pus be evacuated. It is dangerous, however, to leave it alone, especially if deep-seated, for the pus may destroy important textures in making its way to the surface. An abscess under the vasti muscles of the thigh, for example, may, if left to itself, ulcerate into the synovial membrane of the knee-joint, and in like manner, an abscess in the neck may point towards and open through the mucous membrane of the pharynx.

One of the surest diagnostics of the presence of pus in any quantity is the feeling of *fluctuation*, or in other words the sensation of a fluid moving when pressure is made lightly with the fingers on an abscess. In feeling for fluctuation, we should place the points of the fingers of one hand lightly upon the dependent part of the abscess, whilst with the fingers of the other hand we at the same time tap or press gently on the upper part of the swelling. This causes the fluid, if it be present, to impinge on the fingers at the lower part, and communicate a feeling of undulation. Care must be taken not to place the opposed hands too close to each other, as elasticity of the structures may in that case simulate the sensation of fluctuation. It is very important to make out this feeling of fluctuation before making an opening, for some tumours are apt to be mistaken for abscesses, and the treatment in the two cases is quite different. Still, in some cases, as in whitlow or in deep-seated abscesses in the neck or perineum, it is better to make an early incision than to wait for distinct fluctuation, or run the risk of the pus burrowing and thereby endangering important structures.

In the *Treatment* of acute abscess, apply remedies which will tend to favour the formation of pus —namely, heat and moisture ; and this should be done both in superficial and deep-seated abscesses. For this purpose hot fomentations, warm poultices, lint or fine cotton wool soaked in warm water and covered with gutta percha tissue, are used. If the pain be great, anodyne fomentations may be employed, also sedatives, as opium, given internally to procure rest at night.

Fig. 4.

As soon as matter has formed, and sometimes even before it has fairly formed, a free incision should be made into the abscess, so that the pus may be permitted to escape readily. The method of opening an acute abscess will vary according as the collection of matter is superficial and prominent or deep-seated. In the former case the swelling may be transfixed by a sharp-pointed, curved bistoury, and laid freely open by cutting from within outwards, as represented in the woodcut

showing the method of opening a bubo (fig. 4). Where the pus, however, is deep-seated, it is best evacuated by a straight, sharp-pointed bistoury. This should be entered steadily, so as to avoid a sudden plunge when the point has overcome the resistance of the dense integuments, and therefore the point of the knife must be very sharp and thin or double-edged, in order that no force may be necessary in introducing it through the skin. The surgeon, holding the bistoury between his thumb and middle finger with the handle resting lightly on his palm and his forefinger advanced along the back of the blade so as to steady it, enters it perpendicularly (see woodcut, fig. 5) through the coverings of the abscess until he finds the resistance cease. By slightly withdrawing the blade a small quantity of pus will now escape on each side of it. He next inclines the blade so as to divide the coverings with a slight sawing motion. This should be done to the extent of an inch and a half or two inches, so that the pus may have a free exit. In some large abscesses a much more extensive incision will be required—indeed, in cases of acute abscess, it is always right to make a free incision. The pain, at the time, is not greater than in making a smaller incision, whilst a large opening obviates all necessity of squeezing or manipulating the tender parts, and prevents the pus from burrowing. There is nothing more cruel than to make a small or imperfect opening, as it leads to a necessity for subsequent openings, prolongs the treatment, and increases the sufferings of the patient.

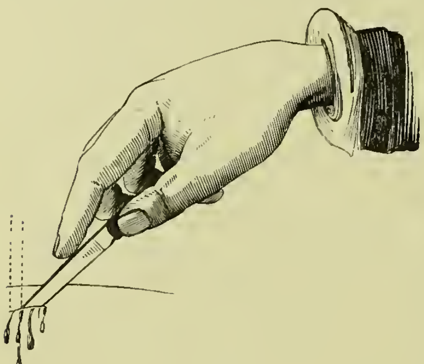

Fig. 5.

Bleeding sometimes occurs in opening acute abscesses, and more especially when they are deep-seated, as the vessels of the inflamed textures are enlarged, and, owing to the cellular condensation, they do not readily retract. In most cases the bleeding is from the margins of the textures divided, and very frequently from some partially-divided vessel at the termination of the incision. In the latter case we prolong the incision slightly, so as to divide completely the bleeding vessel and thus allow it to retract. If this should fail to arrest the flow, the vessel must be tied. When the bleeding vessel is seen in the cut edge, but cannot be drawn out and secured by a ligature, a fine needle may be passed under its orifice and surrounded by a thread or a piece of fine wire. In a few hours the needle may be withdrawn. These measures are preferable to stuffing the cavity with lint and applying compresses, although in some cases of general oozing from the congested cut surfaces a small compress of lint placed between the edges is useful. Bleeding from the cavity of an abscess may arise from some vessel below the abscess which has been wounded by an incautious plunge of the bistoury. In such a case the opening must be freely enlarged so as to enable the

surgeon to expose and tie the vessel above and below the bleeding point. Hæmorrhage from the cavity, however, may take place from vessels which have been eroded during the process of suppuration. In these cases the bleeding does not, as a rule, occur at the time when the abscess is opened, but a few hours later, as the coats of the vessels only give way when the support of the surrounding fluid has been withdrawn and putrefactive changes have commenced. Where the ulcerated vessels are small, strips of lint, soaked in tincture or infusion of matico, turpentine, or a solution of perchloride of iron, will generally prove sufficient to arrest the bleeding. The conditions which lead to this diseased state of the vessels will be treated of hereafter.

The abscess being now satisfactorily opened, a soft poultice, or cotton wool soaked in hot water, either simple or medicated, and covered with gutta percha tissue, may be applied for twenty-four or forty-eight hours. This should not, however, be continued too long, as it may give rise to weak action in the cavity of the abscess. Subsequently, slips of lint dipped in warm water are applied in the form of a many-tailed bandage, so as to cause a moderate amount of pressure on the walls of the cavity, and thereby promote absorption. After a few days slightly stimulating lotions are used instead of the water dressing. The lotion may consist of one grain of sulphate of zinc dissolved in an ounce of water, or a weak solution of chlorinated soda. In the treatment of abscesses the position of the patient is very important. He should be so placed that the opening may be free and as dependent as possible, in order to allow the matter to escape readily.

Diffuse Acute Abscess (fig. 1, plate ii.)—In this form of abscess the pus is diffused through the surrounding textures. Lymph is thrown out to a certain extent, but, owing to the anatomical disposition of the part, this is unable to form a hard boundary around the purulent matter. It is seen when suppuration occurs under the fascia lata of the thigh or deep fascia of the arm. In such cases the pus may spread quite round the limb.

In opening such an abscess a free incision should be made towards its outer and lower part. This, however, may not in every position of the patient be the most dependent part, and hence a free vent will not always be given for the escape of the matter. We must therefore make a counter-opening at a point opposite the first, and some distance from it. If the abscess be very large three incisions are sometimes required. When our first incision is completed we should endeavour to prevent the escape of pus until the counter-opening is made, as this latter can be done more thoroughly and with greater safety when the cavity of the abscess is filled with pus. When, however, the matter has escaped, or when counter-openings require to be made secondarily, a gunshot probe should be passed through the empty cavity to the point at which the opening is to be made. The textures between the point of the probe and the surface are then divided, and the opening enlarged with a probe-pointed bistoury. This method is especially necessary when the cavity of the abscess is in relation to important parts. A piece of caoutchouc tubing —the wall of which is riddled with holes—may then be introduced by means of the probe to permit of free drainage of the abscess and to keep

it open: this, moreover, enables us to wash out the cavity of the abscess. We afterwards apply warm water lint and a light bandage, leaving the openings uncovered. Under this treatment you will generally find that these abscesses, though usually rather large, heal very readily.

Infiltrated Suppuration, sometimes also termed Diffuse Cellular Infiltration, generally occurs as the result of erysipelatous inflammation. The pus is not healthy, but thin and acrid, and possesses destructive properties independent of the bad effects produced by its pressure. There is no fluctuation, but the finger sinks into the skin, and leaves a dimple; hence we say there is bogginess or pitting on pressure. The subcutaneous, and even the intermuscular cellular tissue, becomes infiltrated with pus, and the whole limb assumes a dusky red and swollen appearance. The local symptoms of acute abscess are present, but the accompanying fever is of the irritative type, and the pulse is quick, small, and compressible.

In the *Treatment* of infiltrated suppuration we first apply warm and anodyne fomentations, then make incisions early. Here the pus is infiltrated into the spaces of the cellular or areolar tissue, and on this account one or two incisions are not sufficient. We therefore require to make a number of small incisions about an inch or an inch and a half in length, and then the matter oozes out slowly. Dress the part afterwards with warm-water lint and a many-tailed bandage. Sometimes the incisions must be made through the deep fascia to allow pus infiltrated through the intermuscular cellular tissue to escape. Sloughing is more apt to occur in this than in any other form of suppuration, and thus we must pay especial attention to the constitutional treatment of the patient. We must endeavour to sustain his strength with tonics such as iron, and by giving him appropiate nutrient diet; whilst locally we may require to enlarge incisions to draw out the sloughs of fibro-cellular tissue, which keep up irritation and prevent escape of matter.

LECTURE V.

Chronic Abscess—Diagnosis—Various methods of Treatment—Sources of Irritative Fever—Hectic Fever—Pyæmia.

In Chronic Interstitial Suppuration, or Chronic Abscess (plate ii. figs. 3 and 4), the symptoms are much less marked, and proceed more slowly than in the acute abscess. There is little or no pain, and the swelling, which is often the first indication of the collection, is colourless. There is no local increase in temperature, and hence the name of cold abscess has been given to it as opposed to the acute abscess, where the temperature undergoes a marked increase. On the surface of the abscess we sometimes find swollen veins, as in certain tumours. The progress of the diseased action is very slow. Constitutional symptoms may or may not be present.

The pus which flows from a chronic abscess, on its being opened, is of variable character. The consistence may be creamy, but very often it is thin and whey-like, with flaky masses floating in it. It is never really homogeneous, for there is always some of the flaky matter in the cavity of the abscess. The abscess is lined by a peculiar cyst-like membrane, the inner surface of which is villous or granular. As this is said to be the source of the pus, it is termed the pyogenic membrane. This form of suppuration generally occurs in patients of a strumous or scrofulous diathesis, and is often connected with diseases of bones and joints.

The diagnosis of chronic abscess is not always easy. It is sometimes difficult to distinguish it from certain tumours, such as fatty or medullary. In these tumours there is a feeling of elasticity almost amounting to fluctuation, and there are large veins on the surface just as in chronic abscess. In both chronic abscess and medullary sarcoma the patient has a sort of sallow complexion, so that great care is needed to arrive at a correct diagnosis; and it is most important that a correct diagnosis should be formed, for the treatment of chronic abscess is very different from that of some tumours. Should a fatty tumour be mistaken for a chronic abscess, and an incision made into it, no great harm is done, for the tumour can be excised there and then; but if this be done in a case of medullary sarcoma, the incision will cause the tumour to grow with increased rapidity, and the fatal results will be precipitated.

There is considerable difference of opinion as to the *Treatment* of this form of abscess. Some surgeons hold that it should be opened like an ordinary acute abscess, while others maintain a different opinion. In many cases we delay opening a large chronic abscess, for there may

be no pain or constitutional disturbance, whilst if it be opened, irritative fever may be induced, which often proves fatal. There are cases, however, in which we are justified in interfering—namely, those in which the abscess is quite circumscribed, and in which it is not connected directly with any joint or large cavity. When the abscess communicates with a joint, we should delay opening it as long as possible. When pain and constitutional disturbance supervene, we should, however, open the abscess in order to give the patient relief from suffering, and afford him the only chance of recovery.

The bad symptoms which generally supervene on opening a chronic abscess are the following :—The patient complains of general uneasiness, with shivering followed by pain and heat over the whole body. The skin becomes hot and dry, the urine is scanty and high-coloured, and the bowels generally constipated. There is nausea and vomiting, with a small compressible pulse varying from 120 to 130. The patient has a sunk appearance, and the tongue becomes dry and furred—in a word, he has irritative fever. The frequency with which this fever follows the opening of chronic abscesses deters many surgeons from opening them at all.

The late Mr. Abernethy supposed that these bad symptoms were due to the entrance of air into the cavity of the abscess. He thought that the pyogenic membrane became inflamed in this way and decomposed, and that this set up the irritative fever. He therefore recommended a small valvular opening. The skin over the abscess was drawn up and the opening made. The skin was then allowed to retract, and the result was that the openings in the skin and in the deeper parts did not correspond, and so no air could enter the cavity. In my own practice I sometimes use the exhausting syringe, which prevents the entrance of air; but, at the same time, I believe that the irritative fever which results is due to the decomposition of the contents of the abscess. By making a small opening in it with an ordinary abscess-lancet or trocar, we do not empty the cavity completely. We only draw off the thin part of the pus. The thick curdy matter—the vitality of which is exceedingly low—is left behind, and this, as well as the blood which is poured out into the cavity after removal of the thinner pus, decompose. Noxious gases, such as sulphuretted hydrogen, are evolved; and I believe that it is to the absorption of these putrid matters, and not to the entrance of the air, that the irritative fever is due; for even when opened in such a way that no air could enter, I have seen the cavity of the abscess refill and irritative fever ensue, whilst all the bad symptoms have disappeared on the abscess being laid freely open. I have so frequently seen the best results follow the free opening of such abscesses, that I cannot but think that where we do open them, a free incision to permit the ready escape of noxious matters is less to be dreaded than the pent-up putrescence which so often follows a small opening. When a chronic abscess is not connected with a joint or internal cavity, it may be opened without much hesitation. The wall of the cavity should then be painted with tincture of iodine, which seems to possess antipyogenic qualities and to induce a healthier action in the part. Sometimes we require to make a counter-opening and introduce drainage-

tubing, to enable us to wash out the cavity and inject appropriate lotions into the abscess.

A chronic abscess communicating with a diseased joint is the most dangerous form, because, whatever method we use to evacuate it, irritative fever, exhausting discharge, with hectic, are very apt to supervene. Chronic abscesses near a diseased hip-joint, however, are often opened with advantage. In this case, or in abscess connected with the great serous cavities, the exhausting syringe or aspirator should be used to draw off the pus, not so much to prevent air entering into the cavity of the abscess as into the cavity with which it is connected. Afterwards apply a compress and bandage over the part. Another method of preventing the entrance of air is to open the abscess by a trocar and canula, to which are fitted a stopcock and a piece of india-rubber tubing. The free end of the tubing is immersed in water, and in this way no air can enter the abscess (see plate ii., fig. 3). Should irritative fever set in after the pus has been drawn off in this manner, we must make a free incision into the abscess, with counter-openings if necessary, so as fully to evacuate the contents. We then syringe out the cavity with tepid carbolic lotion and apply warm-water dressings, followed, after a time, by some stimulating lotion, either on the surface or injected into the cavity. Besides the local treatment, the state of the constitution must be attended to. The patient's strength must be supported by nutritious and slightly stimulating diet.

Another method of treating large chronic abscesses has of late years been much employed, viz. the antiseptic method. The principle of this treatment is founded upon the hypothesis that the atmosphere is crowded by innumerable floating and invisible living particles or germs. The advocates of the antiseptic system of surgery maintain that the putrefactive changes in wounds and the bad effects which so frequently ensue upon opening a chronic abscess are solely due to the entrance and mutiplication of these germs in the wound. The great aim, therefore, of these surgeons is (1*st*), in opening the abscess, to destroy the germs or septic producing particles which are floating in that part of the atmosphere which immediately surrounds the abscess; (2*d*), after the abscess is opened, to interpose some material as a dressing between the wound and the atmosphere, which will effectually prevent their entrance. Carbolic acid, boracic acid, salicilic acid, chloral hydrate, are all said to possess properties deadly to these germs. Carbolic acid, however, being a volatile substance, is the one which is most commonly employed. In opening an abscess by this method the skin is first rendered thoroughly antiseptic by washing it with a strong solution of carbolic acid. The atmosphere round the abscess is then loaded with a weaker solution of the acid by means of a spray-producer, and the opening is made. Everything which comes in contact with the wound must first be rendered antiseptic, and, therefore, the hands of the surgeon and the bistoury employed must be dipped in the lotion before the incision is made. The dressing most commonly used is gauze rendered thoroughly aseptic by being impregnated with carbolic acid; but as this acid is irritating to the wound it is better to interpose between it and the wound a piece of dextrin previously dipped in the lotion. The spray must be kept up until the

dressing is so far completed that no air can reach the wound except through the gauze, and it must always be employed at subsequent dressings. Such is the method adopted by those who practise the antiseptic system of surgery with the "utmost rigour of the law." Other surgeons, however, belonging to the same school, are content to attack their foe, the germs, with a less formidable array of weapons, both offensive and defensive. Having soaked a piece of lint in strong carbolic oil, they place it flat upon the abscess, and, raising up the one side of this gently, they make the opening into the abscess, and immediately replace the lint. The contents of the abscess thus make their escape through or underneath the oiled lint. Finally, the portion of lint which overlies the incision is covered up with a piece of tinfoil, which has been previously covered with a thickish layer of carbolic acid paste, and the whole is retained in position by slips of adhesive plaster.

As to the practical results of this latter method I can speak from my own experience, as I have treated a large number of chronic abscesses in this manner. In most of these secondary suppuration was not completely checked, and in many of them irritative fever followed, just as it does when they are treated in the ordinary way.

The method I would advise for opening chronic abscesses, in order that we may evacuate thoroughly the whole contents by a free incision, and yet prevent the access of noxious matters, is to lay a piece of lint or linen rag soaked in carbolised oil over the part to be cut, to insert the bistoury through the lint, and cut to the necessary extent, say two inches. On withdrawing the knife a larger fold of oiled lint or rag is laid over that first applied, and the matter is allowed to escape from under it. After the abscess is quite emptied a piece of waxed paper, covered by a layer of cotton wool and oakum, is applied and supported by a broad roller, so as to make gentle compression over the cavity. If the collection be large a counter-opening should be made, and the cavity thoroughly syringed out with tepid carbolic lotion—1 to 40—before applying the compress and bandage. Should the symptoms of local or constitutional irritation arise, all compression must be abandoned, and warm-water dressings be used. Moreover, the cavity of the abscess must be frequently washed out with boracic acid or chloral hydrate lotions, until the irritation ceases.

The dangers accompanying suppuration, whether in the acute or chronic form, are of two kinds—*constitutional* and *local.*

The Constitutional Dangers are the liability to three forms of fever—the *Irritative,* of which I have already spoken, *Hectic,* and *Pyœmia.*

Hectic Fever either succeeds the irritative fever, or occurs when the discharge of pus is profuse or long-continued. During the day the patient feels comparatively well, but towards evening the skin becomes hot, the pulse rises, and he complains of weariness and lassitude. At night the symptoms are much more intense. Aching pains are felt all over the body, and, after a feverish slumber, the patient awakes in the morning covered with perspiration. The cheeks are flushed, but the rest of the face is pale. The rapidity and compressibility of the pulse increase. The patient gradually grows weaker, and often dies from

exhaustion. Hectic fever used to be considered as an intermittent fever, but it is really more of the remittent type, because, during the intervals between the attacks—that is, during the day—the patient is never perfectly well. In irritative fever the excretions are arrested, but in hectic the urine is often increased in quantity, and may be loaded with urates; whilst, if perspiration be checked, diarrhœa generally comes on. Sometimes, however, it does so while the perspiration continues. This is a very bad sign, and generally precedes the fatal issue.

The treatment of hectic fever consists in getting rid, if possible, of the source of irritation and of the discharge, and in supporting the patient's strength as much as we can by tonics—iron, wine, cod-liver oil, and nourishing diet. If the disease depend on some affection of internal organs, we can only palliate the symptoms, as we cannot remove the source of the irritation, which lies beyond our reach.

PYÆMIA is another of the constitutional dangers. It is generally met with in connection with deep-seated suppuration, and after operations and severe injuries. When pyæmia is about to supervene upon an operation or injury, the pulse keeps high. Indeed, if the pulse do not fall below 100 after three or four days we may suspect something wrong. The disease is usually ushered in by marked symptoms, the most prominent of which are not, however, always the first to appear: the patient is restless, the tongue is dry, the breath has a smell of new-made hay, and—what is a most important symptom—the skin, especially by the side of the nose and about the eyelids, becomes yellow. These less-marked symptoms may exist for two or three weeks before pyæmia decidedly sets in; then there will be a rigor, at first perhaps not oftener than once in the twenty-four hours. In the interval the patient feels well, or merely complains of what he considers rheumatic pains in some of his joints; but soon the rigors become much more frequent, and are followed by profuse perspiration. The temperature is subject to great and sudden alternations. The peculiar odour of the breath becomes more marked; the pulse rises very high; the skin assumes a general yellow tinge; pain is felt over the liver; bronchitis supervenes, and vomiting of dark-coloured matter, and delirium, soon herald a fatal issue. After death, abscesses are usually found in the liver and lungs, sometimes in the larger joints.

Pyæmia, however, may assume a sub-acute character, and this form sometimes occurs after the puerperal state, and also after idiopathic suppuration of the prostate gland. In such cases the symptoms are very severe, and the patient is often in great jeopardy, although the condition is not so grave as in the more acute form. In general, the secondary abscesses which occur in the sub-acute variety are formed superficially or under muscles, whilst the internal organs escape. In some cases of this kind I have opened superficial abscesses which have formed one after another over the whole body, also abscesses under the deltoid, on the hip, and yet the patient has ultimately recovered.

It was formerly supposed that this condition was due to absorption of pus, and to its circulation in the blood, hence the term—pyæmia. This theory is now, however, abandoned, for the injection of healthy pus into the circulation is not found to give rise to the symptoms I

have described. They seem, however, to be due to some ichorous matter either developed there or absorbed from the wound, so that the term ichoræmia would perhaps be a fitter one than pyæmia. It is objectionable, however, to alter names, if it can possibly be avoided, so that I will still adhere to the term pyæmia, begging you to remember the symptoms indicated by the name, and not to be misled by its literal signification. Pyæmia is thought by some to be contagious. When one patient in the ward of an hospital becomes its subject, other patients who have been operated upon only too frequently become victims. This, however, is not sufficient proof of its being contagious. It is said that pyæmia very rarely occurs except in hospitals. Various reasons are assigned for this, but I suspect that pyæmia is not so unfrequent in private practice as is often stated.

Certain low states of the system may be said to render the patient very liable to pyæmia, and of these may be mentioned the dyscrasia attendant upon malignant disease, the exhaustion which follows the prolonged suppuration of necrosis, and the impoverished state of the blood which ensues after any extensive hæmorrhage. Great shock to the system, as that which follows railway or other serious injuries, may also be considered as predisposing to this malady.

As regards treatment, our chief aim should be prophylaxis directed to the improvement of the patient's general health before an operation, for we can do very little when pyæmia once sets in. In many cases I have found iron to be very beneficial, and also the chlorate of potash, but in exactly parallel cases they have done no good whatever. Good nourishing diet should be given, and special attention paid to the ventilation of the room or ward. When abscesses form near the surface of the body, as they sometimes do in the sub-acute form of pyæmia, they must be opened; and as these cases are generally the most favourable, quinine and various other remedies may be given, but none of them are at all certain in their action. All we can do is to try, by supporting the patient's strength, to let nature have as good a chance as possible of eliminating the poison and effecting a cure.

Having thus given you briefly the results of my own experience in regard to pyæmia, I add an abstract of the most recent views on the subject, for which I am indebted to my friend Dr. Braidwood of Birkenhead, who has written an exhaustive treatise on pyæmia.

1. Pyæmia, in all its characters, is more nearly allied to febrile affections than to any other class of diseases with which we are acquainted. It is a fever, and by the use of the expression Suppurative Fever the nature of the disease is indicated.

2. The name suppurative fever is preferable to the current one, pyæmia, inasmuch as the former term is connected with the pathology of the disease, which has always been, and will always remain, the same; while the latter term has been ascribed because of its supposed origin from the admission of pus into the circulation.

3. Suppurative fever is generally ushered in by rigors, and it is characterised by certain definite diagnostic symptoms,—viz. profuse perspirations, a yellowish sallow coloration of the skin and conjunctivæ, a peculiar "heavy" or "sweetish" odour of the breath, extreme pros-

tration, a weak and variable pulse, the development of secondary subcutaneous abscesses and articular inflammations, stagnation of the wound, and a discharge, sanious, fœtid, and of a bluish-green colour. Collectively, these symptoms are pathognomonic, but they are separately met with in very many other diseases. The typhoid nature of the symptoms, for example, renders them very analogous to those induced by certain animal poisons; the multiple abscesses are like those which occur in plague, syphilis, variola, etc., and the blood may in other affections of the system also be loaded with corpuscles identical with pus-globules.

4. Suppurative fever exhibits two sets of symptoms, viz. those indicative of the acute, and those of the chronic disease. The latter form of the fever presents, moreover, three varieties, viz. sub-acute, idiopathic, and relapsing. These terms are in themselves sufficiently well understood, and thus render any definition unnecessary.

5. This disease is divisible into four stages—the stage of incubation, the stage of invasion, the typhoid stage, and convalescence. These stages are always more or less marked, but their duration, from the deficiency of observations at present existing on this point, cannot be definitely stated. They generally commence, however (as far as my observation goes), and terminate on the 7th or 8th, 21st or 22d, and 28th days of the fever.

6. The treatment which, based on a careful consideration of the nature of this disease, and on experience, is likely to be successful, consists in supporting the system by the exhibition of abundance of stimulants, of tonics, of easily digested food; while locally, strict attention to cleanliness and the use of disinfectants are necessary. At the same time it is of advantage to pay attention to hygienic measures, and to isolate patients suffering from suppurative fever.

7. Suppurative fever commences with a morbidly coagulable condition of the blood, and is characterised by the formation of secondary abscesses in the viscera and various tissues of the body. The purulent deposits, as well as the coagula observed so frequently in the veins after death from this disease, are due probably to the coagulable character of the blood. The secondary lesions appear at first as minute spots of congestion, serum or lymph is next effused, and pus is lastly formed. When fully developed they are abscesses surrounded by a distinct zone of congested vessels. They occur most frequently in the lungs, and oftener in both lungs than in either separately; their next most common seat is in the liver; then the kidneys, then the spleen, joints, cellular tissue, muscles, brain, heart, bloodvessels, bladder, intestines, and organs of special sense. The erythema-like blush so frequently observed on the margin of wounds in this disease is owing to congestion and embolism of the superficial cutaneous capillaries.

8. The various circumstances (such as bodily fatigue, shock, hæmorrhage, and the absence of hygienic measures) which predispose to other diseases, may be regarded as predisposing causes of suppurative fever, but the exciting cause of this affection is unknown. The visceral lesions observed after death are traceable to embolia, or rather to emphraxia, resulting from the excessive coagulability of the blood, and are accordingly to be ascribed secondarily to the irritative action of

septic matter about to be eliminated by the organs and tissues. This "materies morbi" is either imbibed by the system or produced originally in the blood. Suppurative fever, moreover, is seldom or never co-existent with any cachexia, and does not require the presence of pus for its development.

9. Suppurative fever is non-contagious, and as a rule not inoculable.

10. The longer the patient's strength lasts, the better is his chance of recovery from suppurative fever; but in forming a prognosis in this disease, the fact must be borne in mind that this is a secondary, not a primary, fever, that it invades the system of a patient who has been already exhausted by wasting illness or by a serious operation. The prognosis must also depend on the severity of the attack, on the nature of the disease which preceded its accession, and on the extent to which the constitution of the patient has suffered from previous illness or accident. Bearing these various points in mind, if the strength of the patient is supported and the other means of treatment are carried out, the prognosis in a case of suppurative fever should be as favourable as in the case of other fevers.

11. From experimental research we learn that very diverse substances introduced into the circulation of dogs produce very similar results; that these symptoms and pathological lesions, like those of suppurative fever, may be induced; but that suppurative fever proper—a disease *sui generis*—cannot thus be produced in animals. Accordingly, that the so-called results derived from this source are very fallacious, and should not be taken into account in the study of this affection. Suppurative fever resembles many other morbid conditions in its not being induced in animals by the injection of morbid fluids. Pus may commingle and circulate side by side with the blood in the vessels, and though it may cause constitutional disturbance it does not necessarily prove fatal.

LECTURE VI.

Local Dangers of Suppuration—From the tendency of Pus to point towards the Mucous or Integumentary Surfaces—From Encroachment on important Structures—From Involvement of Bones and Fascia.

Sinus and Fistula—Causes which oppose successful Treatment—Treatment.

THE LOCAL DANGERS OF SUPPURATION are various and important. They arise chiefly from the mechanical pressure which an increasing suppuration creates on the tissues in its neighbourhood, but in part also from those tissues becoming themselves involved in the ulcerative action. If an abscess be deeply seated under a dense fascia, the pus is thereby prevented from pointing towards the surface, and, being thus circumscribed, it tends to burrow and dissect its way among the surrounding structures, producing in the first place mechanical disturbance, which, by exercising an unnatural and injurious pressure, tends to impair the vitality of the adjoining tissues, and so prepares the way for the more destructive ulcerative action which may follow.

The local dangers of abscess are modified according to its position; and of these dangers the most important may be classified thus:—*First*, Those which arise from the proximity of an abscess to mucous canals or important cavities; *Second*, Those produced by the encroachment of an abscess on important vascular structures; and *Third*, Those arising from the involvement of bones and fascia.

In the first class, the danger arises from the tendency of collections of pus to point towards the free surfaces of the body—the cutaneous or mucous—influenced by the general law, that the direction will be that in which it meets with least resistance. Thus, in abscess in the ischio-rectal fossa, the pus, bounded below by the dense integument of the hip, internally by the ischio-rectal fascia, and levator ani, and externally by the strong obturator fascia, makes its way towards the rectum at the inner and lower part of the space where the ischio-rectal fascia becomes thin and cellular immediately above the sphincter ani, and there it undermines, thins, and ultimately perforates the bowel. The abscess very generally opens also towards the integuments of the hip, and so gives rise to sinus or fistula. Another example may be found in the case of a perineal abscess, where there is great danger of the matter burrowing, and finding its way into the urethra. Again, an abscess situated at the root of the neck is more likely to burrow and extend behind the pleura, or, by ulceration, to perforate it, than find a way of exit through the more superficial textures. If the abscess be situated

higher up in the neck, the matter may press injuriously on or even ulcerate into the larynx or pharynx, and that in a shorter time than it could possibly make for itself an opening externally through the dense fascia of the neck. Then we have, in addition, the too familiar example of a similar destructive process, in the ordinary whitlow, which, if left unopened, leads to destruction of the softer textures, and even of the bone itself; because the aponeurotic sheath of the tendons of the fingers, beneath which it has its origin, being too dense to give way, the inflammation must extend underneath.

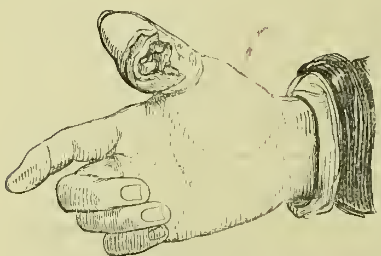

Fig. 6.

The rationale of the processes which cause these dangers being understood, the indications as to treatment must be obvious, and they are simply these:—To make early and free incisions, so as to give ample room for the evacuation of the pus, and thereby avert the evil consequences which we have just been considering.

To the second class of dangers—those arising from the encroachment of an abscess on important vascular structures—belong those cases in which the coats of an artery may be ulcerated through, and serious or fatal hæmorrhage take place in consequence. The very possibility of such a result as an artery giving way in the cavity of an abscess is denied by some; yet the evidence in support of it is to my mind conclusive. An abscess forms frequently over a large artery; and, in such parts as the neck and axilla, where there is abundance of loose cellular tissue, the purulent matter finds ready access to the vessel, and although vascular textures are very tenacious of vitality, yet if they be fairly dissected as it were, by the pus, their vascular supply is destroyed. Their vitality being thus impaired, ulceration follows, the coats give way before the pressure of the circulation, and the blood then escapes into the cavity of the abscess.

It must, indeed, be admitted that the giving way of an artery into an abscess is a very rare occurrence; yet it does sometimes happen. Mr. Liston on one occasion opened such an abscess over the carotid artery. The incision was followed by a gush of blood. He tied the carotid, but the patient ultimately died. The accompanying woodcut (fig. 7) shows the state of the diseased parts in that case. A similar case occurred in our own Infirmary, under the care of the late Dr. Mackenzie. In that instance, however, the abscess simulated an axillary aneurism, and the operation for that disease was performed; but the patient died from secondary hæmorrhage, and on *post-mortem* examination it was found that the artery had been opened into by ulceration from an abscess surrounding it, and that the pulsation so communicated had given rise to the error in diagnosis.* This danger

* *Edinburgh Medical Monthly Journal.* February 1852.

Fig. 6. Result of inefficient treatment of Whitlow.

therefore, should always be borne in mind, as a reason for promptly opening abscesses near vessels. Even if, on opening such an abscess, nothing but pure pus should escape at the time, you must not consider this to be conclusive evidence that the vessel is unaffected, but watch the case carefully, for after a lapse of six or eight hours the artery or vein may give way, and serious hæmorrhage result. This is probably caused by the weakened coats yielding to the force of the circulation, after the equable fluid pressure which surrounded them has been removed, or it may, as stated by some, be due to the entrance of atmospheric air, which hastens putrefaction—and the consequent bursting of the coats of the vessel. At all events, one thing is evident, namely this, that abscesses so situated should be opened early, for otherwise the veins and arteries are in great danger. If bleeding does occur in such a case, the best treatment is to tie the vessel above and below the point where it has given way; or, if the arteries be small and deeply seated, you may succeed in arresting the hæmorrhage by pressure.

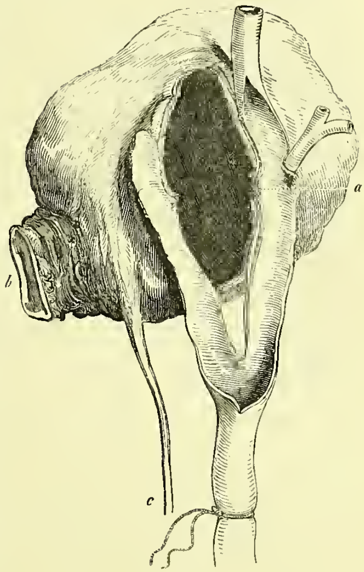

Fig. 7.

The third class of dangers includes those affecting bones and fascia. In some cases of abscess the bone is primarily affected. Thus in the case of whitlow, already alluded to, we have reason to believe that the inflammation does not always begin in the tendinous structures, but sometimes has its origin in the bone itself, and there are cases in which sinuses and fistulæ are prevented from healing by the presence of diseased bone. There are other cases, however, in which a perfectly healthy bone may become diseased by the encroachment of a neighbouring abscess, and have its vitality speedily destroyed. The fascial textures themselves are also liable to become involved in the morbid action, and when this does occur they suffer to a greater extent than do the softer tissues, owing to their denser texture and lower type of organisation. Thus in connection with an abscess of the forearm or thigh, the fascia frequently sloughs extensively.

These examples, therefore, will, I hope, suffice to impress on your minds the importance of opening acute abscesses *early* and freely, so as to relieve the existing disease, and prevent further destruction.

Amongst the unfavourable results of suppuration we often meet with the condition termed Sinus or Fistula. The term sinus is used

Fig. 7. Mr. Liston's case. *b*, The external opening of what was an abscess. *a*, The ulcerated communication between the cyst and the carotid artery; the latter has been sliced open. *c*, The par vagum.—*British and Foreign Review*, No. 29, p. 155.

to express that condition which we meet with in cases where the cavity of an evacuated abscess has failed to contract and heal, but where it remains open and continues to pour from its surfaces a thin unhealthy discharge of a gleety or muco-purulent character. Gradually the walls become thickened and callous, the cavity diminished in size, the lining surface smoothly glazed, like a mucous membrane, the discharge lessened in quantity and altered in quality. The action is sluggish, without tendency to heal, and thus the diseased condition becomes established. On introducing a probe at the opening, it is found to pass inwards in a widening course, while here and there it may meet with projections, which render its progress irregular and tortuous.

After a time the tendency to contraction and closure of the cavity becomes more marked, and the result is that it ultimately assumes the character of a small, hardened, tubular canal. Lymph is effused into the walls of this channel, so that they become very callous and resistant, and possess merely vitality enough to prevent them from sloughing, but not sufficient to produce a healing action. From the inner surface of the canal a thickened moisture exudes.

A sinus may be either straight or tortuous, generally the latter, and it may have either one or two openings. If it has only one opening it is termed incomplete or blind: if it has two—the one opening internally, the other externally—it is termed a complete fistula. An incomplete sinus may have its opening either on an internal or an external surface. In the former case it is more likely to become a complete fistula than in the latter, on account of the tendency of discharges to make their escape through the integument.

The conditions which give rise to the formation of sinus or fistula may be regarded as being partly vital and partly mechanical. The vital causes consist in an original depravity or an induced debility of constitution. The mechanical are—The extent and character of the original abscess; inefficient treatment; special causes opposing successful treatment.

The tendency to the formation of sinus or fistula is regarded by some as being simply a manifestation of the strumous taint in the constitution, hence the frequency with which it is found associated with that habit; and as such patients are also the most liable to suffer from chronic abscess, we find that in a majority of cases sinus and fistula supervene on that form of suppuration. But if the vital powers be lowered from any cause whatever, the liability may be induced thereby, and that all the more if aided by inefficient treatment on the part of the surgeon. For if an ordinary abscess has been only partially opened, or if one opening only has been made where there should have been one or more counter-openings, the pent-up matter does not get free vent, but burrows about and impairs the vitality of the surrounding tissues, thus preparing the way for such results as we have described. Other examples of the consequences of inefficient treatment are found in cases where the diseased condition has been rendered persistent, in consequence of the original abscess having been opened too early, or allowed to remain unopened too long; also where it has been injudiciously stuffed with lint, or where poulticing has been too long continued.

The causes which oppose successful treatment are, for the most part, due either to the anatomical disposition of the part, or to the presence of foreign bodies or diseased bone. Thus, if the original abscess be so situated as to admit of movement of the textures one on another, the cavity may be prevented from closing by the friction of the opposed surfaces as well as by the movements which give rise to that friction. In such cases the parietes do not attain a great degree of callosity, but the surfaces present an unhealthy appearance, and the discharge is thin and copious. Examples may be found in abscess of the leg, or the axilla, or the ischio-rectal space. As the result of an abscess situated under the deep fascia of the leg, a sinus may form, extending from the head of the fibula to the external malleolus, and be kept open by the movements of the part. Or, if the axilla be its seat, the motions of the arm may give rise to a similar result, aided by the facilities for burrowing afforded by the loose cellular tissue of the neighbourhood.

The ischio-rectal space is peculiarly liable to disturbing influences from the movements to which the parts are subjected during the passage of fæces, or the act of coughing; hence this space is a very common seat for sinus or fistula, and here it generally assumes its most persistent form.

The presence of foreign bodies, or substances which act as such, forms another barrier to successful treatment. These may be either intrinsic or adventitious. Generally they are of the former kind, and the removal of the conditions which give rise to them must form a special part of the treatment. Thus, in stricture of the urethra, the irritation may give rise to an abscess in the cellular tissue of the perineum. This may at length open into the urethra, and then the urine will escape into the abscess, where, acting as a foreign body, it will prevent the healing process. At length an opening occurs in the skin, through which the urine passes, and thus a fistula in perineo is established. So long as the urine escapes the fistula remains, and the urine will escape as long as the stricture remains, for such fistulæ always open posteriorly to the stricture—consequently to cure the fistula we must first remove the stricture.

In cases of fistula in ano, mucus from the bowel, or thin fluid fæcal matter, may enter and act as a foreign body, thus keeping up the irritation. In this case we have therefore something superadded to the movements of the parts, which forms a barrier to treatment. In such a case we must cut open the bowel along the whole length of the diseased tract, and divide the sphincter ani, so as thereby to give the diseased parts complete rest.

These two cases—fistula in ano, and in perineo—arise from and are kept up by special causes, and therefore require the special treatment I have indicated.

The *Treatment* of an ordinary sinus, resulting from an abscess, is very simple. A director is passed along the whole extent of the sinus, and the tract laid completely open with a curved sharp-pointed bistoury; or a probe-pointed bistoury alone may be used. Afterwards the application of warm-water dressings, or some stimulating lotion, will promote gradual absorption of the hardened walls, granulation, and cicatrisation.

In most cases this is sufficient, but sometimes, when the tract is very hard, the use of iodine, blisters, and nitrate of silver, as stimulants, may be required. If the part be very hard, or if a portion of dead cellular tissue be present, it may be necessary to destroy it with potassa fusa.

In a very long sinus, as for example one extending from the head of the fibula down to the external malleolus, it would be very severe treatment to make an incision along its whole extent, and in such a case it is better to enlarge the openings above and below to an inch or two in length, then introduce a piece of drainage tubing, or a strip of lint soaked in tincture of iodine, and draw it through the sinus, leaving it for a little till some action is excited. A bandage is then applied, with a view to press the one wall of the sinus against the other, the openings being left uncovered. The sinus soon begins to heal. If, however, the part in the centre does not heal readily, we must make an incision into it and paint it with iodine as before. If this does not cure it, we must open it above and below: and should even this prove insufficient, we must lay it open along its entire length, We may require to apply a poultice, after opening the sinus;—according to some, this softens the callous parts.

In fistula in ano, the rectal wall of the fistula is divided, like any ordinary sinus, with a probe-pointed bistoury. If any collateral sinuses exist, they must also be incised. In fistula in perineo, if the sinus be due to a stricture, the first part of the treatment is to cure the stricture, either by splitting it or by gradual dilatation, or by perineal section. When this is done, the urine passes more readily by the urethra than by the fistulous opening, and often we do not require to touch the sinus at all, as it generally soon heals of itself. If, however, the sinus still continue, we must adopt other treatment. Here we do not require to open up the whole length of the sinus, but merely to dilate the orifice, and to stimulate the fistula, by touching it with nitrate of silver or tincture of iodine, or a red-hot wire.

Fistula in perineo sometimes depends on chronic abscess of the prostate, and is exceedingly obstinate. Unless the prostatic disease be removed, the fistula may prove incurable. Ordinary fistulæ, however, speedily yield to the treatment I have spoken of.

LECTURE VII.

Ulceration; its Nature and Progress—Short Sketch of the Healing Process—Healing by the first Intention: by Granulation—Opinions of the older Surgeons with regard to the Healing Process—More modern Views—General Classification of Ulcers—Ulcers of the first class—Those prevented from healing by defective Action—The Weak Ulcer; its character, progress, and treatment—The Callous Ulcer; its appearance, progress, and treatment.

ULCERATION is another result of inflammatory action. It consists essentially in molecular death of the part. During the process a copious infiltration rapidly takes place, which does not undergo transformation into permanent texture, but obstructs nutrition and becomes broken down and disintegrated, thus causing destruction of the parts in which it occurs. The collected matter gives rise first to swelling; it then points towards the surface by causing small elevations in the more attenuated parts of the superjacent integument or mucous membrane. These at length lose their vitality from the continued pressure of the semi-fluid mass, and give way. Small openings are then established on their surfaces, and each begins to emit a thin ichorous discharge and expose a cheesy-looking matter. The small ulcers so formed tend to increase in number and dimensions until they gradually coalesce, and at length one large open sore or ulcer becomes established.

Such are the stages of the process as it usually occurs in the healthy subject, but ulceration is more apt to take place in patients of an unhealthy constitution, or those in whom the vitality of the tissues generally is below the normal standard. In them, therefore, the plastic lymph, which is thrown out with a view to the reparation of the breaches of continuity, has lower powers of organisation, and the process is proportionally tedious.

When the destructive process has ceased, an effort is made towards repair. This consists in the formation of little bright vascular projections from the hollow and sides of the ulcers, which, being extremely delicate, are generally covered and protected by a thin layer of pus. This also serves to keep them moist, and so favours their growth. These granulations are nourished by small loop-like vessels, which enter at their bases and are prolonged towards their apices. This constitutes Granulation, a process of healing presently to be described.

Ulceration and mortification bear very close relations to each other, the difference being that ulceration runs a much slower course. Perhaps the phagedenic ulcer may be regarded as the connecting link between ulceration and mortification. It is simply a very rapid form of ulceration.

Before you can understand the principles of the treatment of ulcers it is necessary that I should explain shortly the different forms of the healing process. This may take place in two ways, either primarily or secondarily. The former consists in healing by adhesion without the formation of pus, and is termed primary union, or healing by the first intention. The latter consists in healing by granulation after the formation of pus, and is termed secondary union, or healing by the second intention.

Healing by the first intention generally occurs in wounds which have been inflicted by sharp cutting instruments, such as the blade of a knife, provided that the cut be not very large. In these cases, if the incised wound be healthy, and the severed surfaces be placed in close and accurate apposition, we shall find, after an interval of six or eight hours, that the line of union has become coated by a layer of viscid semi-gelatinous matter, by which the edges of the wound are retained *in situ*, and the atmospheric air excluded. These gradually become reddened, painful, and tense; but the swelling which is present is merely excited action. The cut edges become glazed with lymph, the swelling decreases, and in ten days or so the edges are firmly united by newly-formed white fibrous tissue, covered by an epidermic layer.

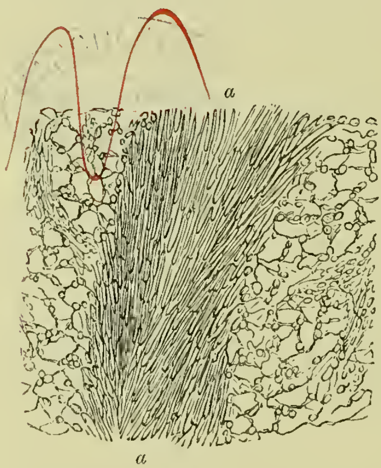

Fig. 8.

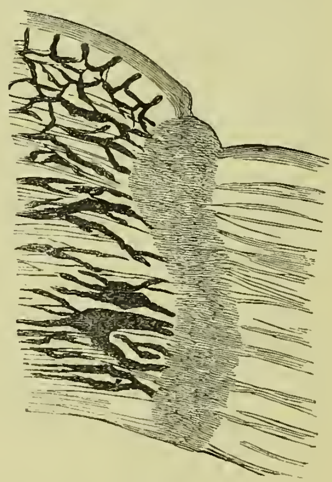

Fig. 9.

The material which connects the two cut surfaces to each other is termed a cicatrix, and at the cutaneous surface this appears in the form of a white mark. The deeper surfaces of the wound are at first glued together by coagulated lymph. Most probably they are united permanently by new-formed fibrous tissue; but we are not certain that this is always the case, for sometimes two cut surfaces unite in such a way that it is impossible to say exactly where the wound has been. In all cases of

Fig. 8. From Billroth, showing a young cicatrix 9 days old. *a a* Represents closely-appressed spindle-cells, binding the two cut surfaces the one to the other, and which are ultimately developed into fibrous tissue.

Fig. 9. From the same author, showing the contraction in an older cicatrix.

union, however, we find that there is some difference in structure between the cicatrix and the natural tissues. In fractures, the material which unites the bone becomes ossified, and resembles in a great measure the osseous texture, but still its character is somewhat different from that of the bone on each side of it. So in the skin, though the cicatrix resembles very closely the skin tissue, we can always distinguish it, even when old, by a slight difference in colour, especially when the part is cold. In scurvy we find fractures and old cicatrices which had healed long before, giving way, showing that there is a difference of vitality between the new material and the old. In muscles the new material never becomes identical with the existing muscular texture, but forms a break in the continuity of the muscular fibres, although the muscle is as useful as before, from the uniting medium joining the other fibres together.

The older surgeons used to think that wounds could heal by first intention, only if the edges were applied together with such exactitude that the mouths of the divided vessels were brought together, each to each, and the nutrition of the part thereby secured. We now know, however, that too much pressure gives rise to morbid instead of healthy action, and therefore we have recourse only to very slight dressing in the treatment of such wounds. A strip of dry lint should be laid along the line of union, and no other dressing used. The lymph will then form with the lint a covering, which gives additional protection, and at the same time prevents the entrance of atmospheric air. I said *dry* lint, for no wet dressings should be used, as these tend to disintegrate the lymph, and so prevent the formation of an adhesive coagulum over the wound. The part should also be kept cool, for a high temperature tends to produce excitement, and favours the development of pus from the cut surfaces.

Healing by second intention, or by granulation.

When a wound fails to heal by the first intention, it gradually assumes the appearance of an ulcer; suppuration takes place on its surface, and under the thin superficial layer of pus a number of small bright-red acuminated granulations are formed. In minute structure these granulations consist of delicate fibro-plastic cells and fibres, with a minute loop of bloodvessel. The fibro-plastic cells give off from their surface a series of prolongations, which go to the formation of white fibrous tissue.

According to the cell-pathologists, these fibre-cells are formed from the nuclei of pre-existing fibrous tissue. But according to the molecular pathologists, they are formed from an exudation. The pus which covers the granulations is said by the former authorities to be formed from the cells of the granulations, while the latter suppose it to be the result of an exudation thrown out on their surface.

The older surgeons supposed that in the case of ulcers the process of healing was effected by these granulations forming new texture, layer after layer, until the cavity of the sore was filled up. As to the cicatricial fibrous tissue which ultimately covered it in, its origin was a disputed point. Some held that it might be thrown out from any part of the granulating surface, while others believed that the cicatrix spread always from the skin at the margins of the sore and extended inwards

towards the centre. This is now known to be the correct theory. Sometimes we have the appearance of detached islands of cicatricial texture forming in the area of the healing surface; but in such cases the cicatrix is always developed from portions of true skin which have not been destroyed by the ulceration. This is very well exemplified in cases of burns and scalds, where the whole surface of the wound looks red and granular, although the whole of the true skin has not been destroyed; so that what looks like the granular surface is really the skin, and from it the cicatrix spreads. In all cases, however, in which the ulceration has led to complete loss of skin on the surface, the sore heals from the circumference to the centre.

It is thought by some that in secondary union the sore heals entirely by contraction, and that the granulations never fill up the hollow. They say that if we lôok at the cicatrix of an old ulcer we always find a depressed cicatrix; whilst, had the wound been healed by filling up, the cicatrix would have been level with the surface.

According to these authorities the depth of an ulcer depends upon the swelling of the surrounding textures, and thus the real loss of tissue is not nearly so great as it seems to be. The healing of a sore, they maintain, is due entirely to the subsidence of the inflammatory action, and the disintegration and absorption of the exudation; the swelling and tension being thus reduced, the surface of the sore is diminished from the edges of the relaxed skin approaching each other. This doctrine, in its essential points, is the true one, but it goes too far when it affirms that *no* new material is formed. For example, in ulceration over a bone when the periosteum has given way, as the ulcer heals there is a layer of granulations spread over the bone; the wound heals principally by contraction, but there is always a certain amount of new fibrous tissue formed by the granulations, though not enough to fill up the cavity of the sore.

When there is much muscular texture lost and not much skin, the wound will heal very rapidly, and with a very small cicatrix; but when much skin is lost, by sloughing, a large cicatrix is formed, and contraction of the part follows. I believe, then, that in all cases of healing by secondary union there is a small amount of new texture formed from the granulations; that the cicatrix grows from the surrounding skin, and that contraction of the surrounding parts is the chief cause of the closing in of ulcers.

The cicatrix is a substitute for skin. It consists of white fibrous tissue, covered by an epidermic layer, and is very unyielding, being firmly attached to the subjacent textures. Its vitality is low, in consequence of which it easily dies when inflammation is set up in it. Usually it is possessed of but slight sensibility; at other times, however, it is extremely sensitive.

Ulcers may be classified as follows:—

1. Those in which ulceration is slow and the healing process seems to be prevented by low vitality and defective action. Of these we have good examples in the Weak and Callous ulcers.

2. Those in which the ulceration progresses rapidly and the healing process is prevented by over-excitement, excessive action, or irritability

of the part. This class is exemplified in the inflamed and irritable ulcers.

3. Ulcers in which healing is prevented by specific action, as in the case of strumous, syphilitic, and cancerous sores.

To the first class belong the *weak* ulcer, and the *callous*, indolent or chronic. These two, although classed together, are nevertheless widely different in their character, and require different treatment.

The WEAK ULCER may owe its character either to diminished vitality of the part or to debility of the constitution generally. The following distinctive features may enable you to recognise it:—You will find the surrounding skin to be pale and yellowish in colour, usually soft, but sometimes œdematous; the surface of the sore is elevated above the level of surrounding parts, and is covered over with exuberant granulations, which sometimes present a purple congested appearance, and sometimes assume a pale, flabby, pinkish or yellowish colour, but never the bright red colour presented by a healthy healing sore. The margins are generally either colourless, or of a pale purplish colour, and the surrounding integument either may or may not be swollen and œdematous.

You might very naturally suppose that these exuberant granulations were an indication of active growth, but such is not the case, for although excessive in quantity, they are greatly deficient in quality. They are merely badly-formed granulations, infiltrated with serum, and they are entirely different in character from the short, firm, solid granulations, which are to be seen in healing sores, or in the ulcers of strong and healthy patients. Sometimes the granulations give way, and then the contained serum is poured out on the surface, and a yellowish, sloughy appearance is produced. A somewhat similar result sometimes follows the injudicious application of a stimulating lotion.

Ulcers arising from burns or scalds are always weak, owing to the impaired vitality of the part and the slow process of healing, together with the extreme exhaustion of the constitution which always follows severe burns. In other cases the weak action arises from constitutional causes; any injury inflicted on a person of feeble health may give rise to a weak ulcer.

Like most other ulcers they are more commonly met with in the inferior than the superior extremities. This is due to the fact that the lower extremities are more liable to exposure and violence than the upper, and they are also more apt to be congested from their dependent position. Weak ulcers are, however, oftener met with in the arm than any other ordinary form of ulcer.

The *Treatment* consists in endeavouring to invigorate the part and the system generally. We destroy the unhealthy surface of the sore in order to establish in its place a more healthy process of granulation. This we do by painting the surface lightly with solid nitrate of silver, and afterwards applying lint dipped in warm water, or moistened with a slightly-stimulating lotion, such as a solution of sulphate of zinc, 1 or 2 grs. to the oz. of water; or a weak solution of chlorinated soda. We place the part at rest, and give local support by means of methodical bandaging, in order to remedy or prevent œdema, or congestion of the

limb; and, in addition to all this, we endeavour to support the constitution by the administration of suitable nourishment, and stimulants if necessary. In cases of severe burns and scalds we must be prepared to receive a check every now and then in the healing process. The structure of the ulcer and the texture beyond has undergone consolidation, and has had its vitality impaired; but, generally speaking, by the treatment I have indicated, you will at length succeed in effecting a cure. The form of local stimulus should be changed from time to time; say from chlorinated soda to sulphate of zinc or sulphate of copper, of the strength of 1 or 2 grs. to the oz., or black-wash, which consists of 4 or 5 grs. of calomel added to the oz. of lime-water.

The CALLOUS, INDOLENT, or CHRONIC ULCER, is much more common than the weak ulcer. It generally occurs among the poorer classes, and as these patients cannot observe the conditions necessary for its cure—namely, rest and proper treatment—it becomes, in their case at least, somewhat intractable; for often, after it has been so far healed, the patient goes back to work, and the ulcer is reproduced in perhaps a worse form than before. The characters of the callous ulcer are well marked. The sore is generally large and deeply excavated; its margins are white, rounded, and callous; its surface presents an orange or brownish varnished appearance, or is coated by a thin sanious discharge when irritation is present; it is seldom covered by granulations. The surrounding skin is thickened, hard, and discoloured, generally assuming a purplish or bluish grey tint, and the whole limb usually becomes considerably swollen and deformed, presenting sometimes an appearance not unlike the condition known as elephantiasis.

In the weak ulcer there is an appearance of overgrowth. Here we have no growth at all—no granulating surface, but the appearance of great destruction of texture. I say the appearance, for in reality the ulcer has not dug deeply, but the thickened margins and swollen textures surrounding it make it appear deep, and this appearance is very characteristic. It is to the thickened and elevated margins and to the surrounding induration that we must look in order to ascertain the true nature of the sore, for these are conditions which prevent successful repair. The thickening is due to the solid chronic œdema of the cellular tissue around the ulcer, and this, by distending the skin, separates still farther its margins, and produces a constant tendency to increase rather than diminution of the ulcer. Fortunately for the patient, this form of sore is not very painful.

The callous ulcer often supervenes on the varicose, as that condition of the veins tends to favour œdema of the limbs, and consequently the development of such ulcers.

Treatment.—The first indication is to get rid of the chronic œdema, and formerly, with this in view, the surgeon had recourse to the application of bandages and plasters; but now we adopt a much quicker and surer mode, which consists in the application of a fly-blister. This acts as a deobstruent, and under its influence the hardened margins slough, the exudation becomes absorbed, and healthy action begins.

The first thing to be done is to keep the patient perfectly quiet, in

a recumbent posture. After a day or so we apply a blister round the sore. When the ulcer is large it is best to leave the surface of the sore uncovered by the blister, because in the centre there is not much exudation to be got rid of, and there is a risk of over-excitement in the sore, and of absorption of the cantharides, by which strangury might be produced. When the ulcer is small we may apply the blister over the whole surface. The blister is to be kept on for ten or twelve hours, until it begins to rise. The skin will not vesicate as healthy skin does, but sufficient irritation will be excited. After the blister is removed we apply warm-water dressings, or a soft linseed-meal poultice over the blistered part. Under this treatment the margins of the sore, which have little or no vitality, generally slough and leave a healthy margin. At first the skin appears more swollen, and the surface of the ulcer looks less healthy, but gradually the swelling diminishes, and after four or five days the skin feels soft again, the surface of the sore becomes granular, and loses the varnished appearance which it had at first, and the ulcer begins to assume a more healthy character. We then apply a bandage from the foot upwards, with strips of warm-water lint crossing over the surface of the sore, so as to act like a many-tailed bandage. This supports the limb, and also acts as a gentle stimulus, and the exudation rapidly disappears. This treatment is to be continued for about a week, and then some stimulating lotion may be required. The ulcer diminishes very rapidly in size, owing to the relaxation of the skin, which arises from the cellular tissue being relieved of the exudation. After a time the action may flag, and then we must attend to the patient's health, and begin to apply more pressure, and paint over the surface with tincture of iodine to produce renewed action. Should, however, the ulcer still refuse to heal, apply a second blister over those parts where the exudation is greatest, for the exudation is often thrown out in irregular masses. Lastly, when the ulcer becomes very small, we bandage the limb firmly from the foot upwards, and bring the margins of the sore together by broad straps of adhesive plaster, as shown in woodcut (fig. 10). The plaster treatment should only be used when there is a very small sore.

Fig. 10.

Another plan of treatment has been proposed for callous ulcers, which is founded on the principle of facilitating contraction of the sore by relieving tension of the integuments. This consists in making long collateral incisions through the skin on either side of the ulcer, in the hope that its margins will thereby be allowed to contract. This method of treatment is occasionally useful; as a general rule, however, it is

objectionable, because one or two new ulcers might form where the incisions were made. It may be employed sometimes when there seems to be an adhesion of the integument, but otherwise it does not answer so well as the treatment previously described.

I advise you not to apply blisters to callous ulcers when you find the urine highly albuminous, as that indicates disease of the kidneys; and in such cases the swelling of the limbs is general, and dependent largely on the diseased kidneys, and a blister will not remove it; moreover, the active principle of the blister, cantharidine, may be absorbed, and cause still further irritation of the kidneys.

Some have thought that the thickening of the edges of the ulcer resembles the callosity of the skin called a corn, and have recommended that the skin should be sliced away as we would do a corn. But this is only an example of the bad treatment to which a bad pathology leads. A corn is due to thickening of the epidermis, whereas the thickening of the skin around a chronic ulcer is due to exudation in the true skin and subcutaneous areolar tissue.

LECTURE VIII.

The Inflamed Ulcer: its appearance, progress, and treatment—The Irritable Ulcer: its characters, causes, and treatment—The Constitutional Sore: its causes, appearance, and treatment—The Serpiginous Ulcer.

The second class includes ulcers prevented from healing by excessive action. Two ulcers are included in this class—the *Inflamed* and the *Irritable*.

The Inflamed Ulcer.—A sore may possess this character from the commencement, or one of any other kind may assume this form. It is recognised by a bright red colour of the skin, irregular eaten-out margins, and a viscid unhealthy discharge, which is frequently mixed with blood. Its surface is covered with florid, vascular, and very sensitive granulations, or by an ash-coloured slough. The surrounding integument becomes tense, glistening, and painful; in colour it varies from bright red to a crimson or lake, and its temperature becomes elevated considerably, although not to a degree equal to the sensations of the patient. The blush or discoloration of the skin is not limited to the immediate vicinity of the ulcer, but may extend for a considerable distance up and down the limb. The swelling is also diffuse, and owing to the pressure of the unhealthy exudation which is poured out into the areolar tissue, disintegration takes place, and small outlets or ulcers are formed, separated by narrow bridges of skin, and gradually merging towards one another. These bridges at length give way, and a large ragged ulcer is formed.

This condition is attended with all the cardinal symptoms of inflammatory action. The limb has a pulsating feeling, and sometimes becomes erysipelatous. The surface of the sore often takes on a sloughing action, and gangrene may supervene. An example of this is sometimes seen in acute inflammation of the glans penis, which is frequently followed by death of the part. When the inflammatory action is confined to the site of the ulcer, little constitutional disturbance accompanies it; but when the inflammation is extensive it is attended with considerable distress; the pulse becomes quick, hard, full, and the other febrile symptoms manifest themselves.

The causes which give rise to such an ulcer may be of an endemic or of an epidemic nature, but most commonly it occurs as the result of the irritation of a sore already existing; from the part being overstimulated, as by cold, heat, exercise, or some irritant.

Treatment must necessarily be of a twofold character—local and constitutional—and each must be modified according to circumstances.

In most cases it must be active. If symptomatic fever be present, apply simple poultices to the sore, together with opiate fomentations to the inflamed portions of the limb. If there be a great amount of tension in the part, we endeavour to relieve it by means of incisions or punctures along the limb, and afterwards by bathing or fomenting it. Thus, the serous discharge is favoured, the inflammatory congestion of the part relieved, and the acute œdema frequently dispersed.

Where there are bridges of skin as already described, they should be simply cut across. By so doing you deplete, relieve tension, and allow the skin to retract and the matter to escape. This, instead of destroying, really becomes the means of saving the skin, for if not so divided it would speedily ulcerate and slough away. The escape of the exudation should be favoured by the application of poultices.

If a black point begin to form, apply a charcoal-poultice, or lint soaked in warm water and charcoal, as an antiseptic to the sloughing part. There is no remedy equal to charcoal for checking this form of diseased action. The charcoal-poultice is made by dusting a little powdered charcoal over the surface of an ordinary linseed-meal poultice. After its removal, warm-water lotions containing opium should be applied, and the warmth carefully sustained between the fomentations.

When the acute action has subsided, granulations of a normal kind begin to appear, the skin contracts, and the healing process is established. The local treatment at this stage is a matter of some importance, and great care must be taken to avoid doing either too little or too much. Warm-water dressing must be continued for some time before using local stimulants. The after-treatment consists in the use of such lotions as are suitable to the general treatment of a healthy healing sore. The part should be bandaged in order to give support and to afford the slight stimulus of pressure, but great care must be exercised in regulating the amount of that pressure. The "many-tailed" is the best form of bandage to apply. It should be made of lint, and applied after being wrung out of hot water.

Constitutional Treatment.—This should consist chiefly in the use of opium and antimony, and in the careful regulation of the diet. The antimony is given to reduce the circulation, and by its use a more heroic treatment may often be avoided. If the patient cannot tolerate antimony, we give diaphoretics, such as the compound powder of ipecacuan and opium, or small doses of the acetate of ammonia. If the inflammation should change to an erysipelatous type, then give tincture of the muriate of iron, in medium or large doses, three or four times a day watching its effects. Camphor mixture, with sweet spirit of nitre, may be given in small doses, so as to act gently on the kidneys, with large quantities of bland diluents to wash out the tubuli uriniferi.

The great danger to be avoided with regard to diet is over-stimulation at first. Give mild and nutritious diet to begin with, gradually increasing the quantity and strength according to the requirements of the case.

The Irritable Ulcer, although placed in the same class as the foregoing, is widely different in character and appearance. It is attended

with little or no surrounding inflammation, and the parts in its neighbourhood do not become swollen or tense. It owes its origin almost entirely to constitutional causes, and is most frequently associated with some form of uterine disturbance; hence you will find it very often in females who are suffering from amenorrhœa or menorrhagia. Unlike the ulcers which arise from local causes, this generally manifests itself in a particular part of the body; and the site where it is most frequently found is low down on the fibular aspect of the leg, just above the external malleolus.

In appearance it resembles the condition you would find if you sliced the top off a large boil, leaving a hard raised base with a flat surface and somewhat uneven edges. These edges are not irritable at first, but as ulceration goes on the base is gradually absorbed, and then the edges become inflamed. The surface of the ulcer is covered with reddish-brown granulations. Before surrounding inflammation sets in there is intense pain, which becomes aggravated by the slightest touch. At night there are always extreme exacerbations, which give rise to a condition so intolerable that the patient is deprived of sleep. Under this the general health gives way. The patient loses appetite and flesh, the tongue becomes foul, the pulse quickened, the digestive system deranged, and low febrile symptoms are developed. All this may occur without the local inflammation extending far. A peculiar morbid nervous irritability in and around the margins of the sore is characteristic of this form of ulcer.

The *Treatment* varies according to the view taken of the pathology of the ulcer. Opium has been greatly recommended both externally and internally; but although I advocate its local application in the form of fomentations, I cannot say that I so highly approve of its internal administration. I am inclined to think that it will be more likely to do harm than good, by deranging the digestive organs and arresting hepatic secretion. By far the best treatment, in my opinion, is to exhaust the morbid irritability of the sore, in the early stages, by means of a thorough application of the solid nitrate of silver. It must not be applied lightly, but must be rubbed into the sore strongly and thoroughly. This remedy is undoubtedly painful at the time, but it is followed almost immediately by the most complete relief; the nocturnal exacerbations are got rid of, and opiates are thus rendered unnecessary. The part should be treated afterwards with warm-water dressing, and supported by bandages. If opiates have been given, they should now be withdrawn, and tonics, especially chalybeate tonics, administered instead, together with a nutrient diet. This method of treatment will seldom fail to cure the irritable ulcer.

It must be remembered that though in irritable ulcer you may have sometimes severe inflammation set up, with determination of blood to the part, yet these are only accessory and adventitious conditions, and form no part of the special characteristics of the ulcer.

The third class consists of ulcers which do not heal on account of specific action, or peculiarity of action. Under this head come *cancerous* or *cancroid*, *syphilitic*, *strumous*, and *scorbutic* ulcers. The surface of these sores is very peculiar. It is generally covered with a sloughy

material of a dirty-grey or pale-yellow colour, and emits an unhealthy discharge.

The margins may be thickened and rounded, or irregular and ragged, and are liable to be modified by rapid inflammation attacking the original sore. The ulcer appears as if scooped out with a gouge. Its form and peculiarities, however, are chiefly determined by the constitutional conditions which accompany it, and these must in all cases be our guides as regards the treatment. We can follow no fixed indiscriminate rule, but must adapt our remedies to the constitutional peculiarity. Thus, in some cases of cancerous ulcer we have no hesitation in cutting out the sore, provided the patient be strong, the disease still distinctly localised, and the neighbouring glands unaffected, for by doing so we prevent the disease from spreading by continuity to the adjoining textures, and perhaps save the system from being involved in the morbid action. On the other hand, if a case having a similar history should be seen for the first time after the neighbouring tissues and the constitution have become affected, our treatment must be merely palliative, for active interference in such a case would only accelerate the destructive process. Although it is probable that the primary cause of the affection is to be found in some peculiarity of constitution in the blood or in the solid textures, it is nevertheless true that the local disease acts as a germinal centre for the propagation of the malignant action, and supplies materials for the development of morbid deposits in other regions of the body. So that, by timely excision we not only delay the fatal result, but give the patient the only chance of permanent immunity from the disease.

In other forms of specific ulcer, due to constitutional causes, we do not have recourse to removal by the knife, because the parts beyond would immediately take on the diseased condition, but we combine internal remedies with local treatment. In primary syphilis, for example, we treat the local disease by applying escharotics so as to destroy the surface of the chancre; and if constitutional symptoms afterwards appear, we give mercurials along with iodide of potassium—but we do not excise the ulcer. In scrofulous ulcer, which is chiefly dependent upon the constitution, the special treatment is entirely constitutional.

Some forms of ulcers of this class require particular notice, and of these we shall *first* consider the so-called CONSTITUTIONAL SORE, or Cellular Tissue Ulcer. This is a chronic form of ulceration dependent upon constitutional causes. It is often the result of struma and syphilis combined, the syphilis being of the tertiary form. The patient, as might be expected, is generally pale and anæmic, and has a cachectic expression. The ulcer varies in appearance according to the part it attacks. When situated in the limbs it somewhat resembles the callous sore, being equally deep and thick at the edges, but these are rather more rounded and irritable. The surrounding skin is of a more delicate shade of colour; for while in the callous it is dark and purplish, in the constitutional it is light and pinkish. They both present the same glazed appearance on the surface. The thickened margins are due to exudation into the cellular tissue beneath the skin, but the exudation is always aplastic and circumscribed in its extent. It seems to be thrown out only

in the neighbourhood of the diseased part, and so the swelling is limited to the immediate vicinity of the ulcer or ulcers; for frequently the neighbourhood becomes dotted over with a series of smaller sores. In this form of ulcer we have a marked contrast to the callous sore, for where the latter exists, the limb, as we have already indicated, becomes irregularly swollen and thickened throughout, giving rise to a condition resembling elephantiasis.

The *Treatment* must be both local and constitutional. In the earlier stages, when there is considerable swelling present, the application of iodine or of a blister over the exudation and round the margins of the sore will often serve, as in the case of the callous ulcer, to cause absorption of the exudation and to stimulate the sore to a more healthy action. More sloughing and disintegration, however, may be expected to follow here than in the case of the callous ulcer, owing to the lower vitality of the exudation in this form of ulcer. After removal of the blister warm-water lint-dressing and bandages should be applied for a few days. Thereafter it may be treated by local remedies, to get rid of the fœtid discharges and to promote healthy granulations. For this purpose we may use the chlorinated soda lotion or a solution of permanganate of potash, followed by a weak black lotion. Under this treatment the remaining exudation will gradually diminish, and a healthy action set in.

Meantime the constitutional treatment must not be overlooked. Such ulcers are generally associated with tertiary symptoms or with an inherited syphilitic taint. The use of mercurials internally is rather contra-indicated, and the iodide of potassium should be used instead. This remedy may be given in five-grain doses twice or thrice a day, and may with great advantage be combined with small doses of arsenic—say three to five drops of Fowler's solution to each dose of iodide. They should be prescribed separately, so that one or other may be discontinued as occasion may require. By and by other remedies may be given, and of these certain chalybeates are often beneficial, more especially the syrup of the iodide of iron. Cod-liver oil may also be given with advantage, and the diet should be carefully regulated and be of the most nourishing description.

Sometimes the ulcer may assume characters different from those I have described; for example, it may become *serpiginous*, where a number of small points creep together, as it were, in a somewhat serpentine course, and then coalesce so as to form a large ulcer. In such cases, the application of sulphate of copper will be found preferable to a blister. The stimulating lotions, of whatever kind, should be changed from time to time, so as to maintain their action; and thus sulphate of copper, nitrate of silver, and sulphate of zinc, may all be used in succession with advantage. We do not wish to increase the strength of the stimulant, but to change its form from time to time; for use seems to weaken its effect. In this case also the patient should be allowed good diet, and cod-liver oil may be taken with benefit, together with the iodide of potassium and arsenic.

LECTURE IX.

Lupus or Rodent Ulcer : its Varieties, Progress, usual Site ; its Treatment, Local and Constitutional—Scorbutic Ulcer : the Conditions which precede and accompany it ; its Treatment—The Varicose Ulcer and its Treatment—Phagedenic or Sloughing Ulcer : its Nature and Varieties—Acute or Black Phagedæna : Development, Characters, and Course ; Febrile Condition which accompanies it—Grey Phagedæna : its Local Appearance and Constitutional Symptoms—Causes of Phagedæna—Practical Hints and Details with regard to Hospital Ventilation—Treatment of Phagedæna.

Lupus or Rodent Ulcer is a form of specific ulcer very like the cancerous, and often confounded with it. It occurs sometimes in connection with the syphilitic taint, but most frequently with the strumous diathesis. Lupus may commence in either of two forms. The one has been described as tubercular; the other as herpetic. In the first form the skin becomes thickened and has a tubercular appearance. In the latter form the skin breaks out into small pimples, each of which bears a vesicle at its apex. These at length coalesce, and then burst and form a sore. The base becomes thickened and the sore gives off a dirty grey discharge. These small sores tend to become gradually larger and more irritable, until at length they merge into one, assume a tubercular form, and true lupus is established.

The site where it occurs most frequently is the nose, cheek, or angle of the mouth, and the progress is both rapid and destructive. When it attacks the nose, the lupus is generally of the tubercular form, and after the ulceration has proceeded for some time it assumes the following characters :—The edges of the sore are red, ragged, and irritable. At first they present a sharp outline, as if cut out, but are not much thickened or hardened. They therefore give way rapidly, and so the ulcer extends both in surface and in depth, eating outwards, irregularly, in different directions, until at length the whole side of the face may become one mass of disease. The surface of the ulcer is uneven, of a dirty grey or ash colour, and exudes an unhealthy-looking discharge. Lupus is attended with a peculiar burning heat in the part, together with excessive pain, and is very often accompanied with fever of a low hectic kind.

The *Treatment*, like that of the other specific sores, should be both local and constitutional. If in a strumous patient we find this form of herpetic eruption, or the tubercular masses beginning to form, we may have recourse to the local application of soothing remedies, such as anodyne solutions. If, notwithstanding this, the disease still advance, we must begin more active treatment at once. The surface of the ulcer

should be destroyed throughout its whole extent by the application of sulphuric acid or potassa fusa. Nitric acid is more generally used for this purpose; but I object to it because it has the effect of coagulating the albuminous constituents of the textures, and thus forming a barrier which prevents its full caustic action on the whole extent of the diseased surface beyond. Afterwards simple warm-water dressings, to which a little of Condy's fluid has been added, are to be used until the irritation ceases. When the slough produced by the escharotic separates, the denuded surface may be treated with weak black lotion, which sometimes heals it up very rapidly. Should that fail, however, and the sore threaten to extend, sulphate of copper may be applied either in the solid form or in saturated solution. In such cases, the sulphate will be found very useful; it being in fact almost a specific for lupus. When much irritation exists, the stimulating lotions should be discontinued, and warm-water dressings resumed. It is well to bear in mind that an old lupoid sore may assume a cancroid character, and in this case it must be removed by the knife.

Meantime the general health must be carefully attended to. Iodide of potassium should be administered in three or four grain doses, along with either arsenic or cod-liver oil, according to circumstances. Or, should the patient be very anæmic, the syrup of the iodide of iron may be given at first, along with cod-liver oil. Quinine, although useful in the later stages, should not be ordered in the earlier, as it is too stimulating to be of service then. Occasionally a gentle saline purgative may be of use, and although, as a rule, it is not advisable to give mercurials, yet they may now and then be combined with the saline, as alteratives, with advantage. The diet should be of a simple nutritive kind, and if wine be given, it also should be light, and given sparingly.

Lupus has a great tendency to return, and therefore, although the medical treatment may be intermitted, the nutritive should be continued for some time afterwards.

As might be expected, this disease, however well treated, often results in great deformity; and for the remedy of this defect, plastic operations are often required. Let me warn you, however, never to operate without the greatest caution, for, as I have already said, very little irritation will cause the lupus to break out afresh. You ought therefore to wait for at least a year after the cessation of the disease, and complete cicatrisation of the wound, before proceeding to operate, for if you do so earlier bad results are almost certain to follow.

The Scorbutic Ulcer is a form which we occasionally meet with in practice. It arises during the progress of scurvy, and is therefore found amongst those who are most liable to be affected with that disease—namely, sailors or the navvies employed on railways. These men live mostly on salt provisions, seldom tasting either milk or vegetables, and thus, whether landsmen or seamen, they soon become affected with scurvy. I have seen the disease occur on board ship, even where the necessary precautions regarding diet had been used, and a plentiful supply of lime juice, preserved milk, and vegetables provided. In such cases it arises from special conditions, as close confinement, bad air, and debilitated constitutions.

True scurvy begins in a somewhat peculiar way. The symptoms are at first those of languor and weakness; at length uneasiness, almost amounting to pain, is felt, and attention is drawn to a peculiar ecchymosed appearance generally over the front of the tibia. This condition precisely resembles that which might be produced by a bruise. Its colour deepens towards the centre, and gradually shades off towards the circumference, the surrounding skin being of a yellowish hue. The limb is sometimes slightly œdematous, but presents no breach on the surface. By and by patches of a similar kind make their appearance on other parts of the body. The pulse becomes weak, the gums spongy and tender, and there is often bleeding from them and from the nose, with fœtor of the breath. Over one or other of the affected parts the skin at length gives way, and a scorbutic ulcer is formed. The ulcer, although weak from the first, extends very rapidly, so that it may, within forty-eight hours, assume rather formidable dimensions. Bleeding takes places from the surface from time to time, and at length a large fungoid mass protrudes from the centre, having the appearance of boiled liver—or "bullock's liver," as it is sometimes called by sailors—and consisting chiefly of imperfectly clotted blood, the fibrin being thrown out, and formed into a spongy mass. The surface of the sore presents an unhealthy brownish appearance, and the patient complains of great lassitude and weakness.

The treatment of the scorbutic ulcer must be almost entirely constitutional, so as to get rid of the depraved condition of the system which gives rise to it, for until this be effected local remedies are of no use whatever. As the cause is generally improper diet, so the treatment must consist in correcting that defect, and with this in view we administer milk and fresh animal and vegetable food, together with fresh fruit—such as oranges and apples, if obtainable—and acidulated drinks, such as lime-juice, or other vegetable acids diluted with water. The administration of fresh vegetables should be guarded at first, as they are apt to produce diarrhœa. Slight stimulants may be given in the form of light wines, and of these claret is the best.

Under this treatment the symptoms of debility soon pass away, the ulcer ceases to bleed and assumes a healthy character, the fungoid mass drops off, and the part may be afterwards treated as an ordinary healing sore. Should bleeding occur from the surface of the ulcer during its progress, either spontaneously or from improper attempts to remove the fungoid mass, it must be arrested by the application of some styptic preparation, such as tincture of perchloride of iron or tincture of matico. The epistaxis, if troublesome, should be arrested by plugging the nostrils. In this disease comparatively slight exertion on the part of the patient may be followed by fatal syncope, and hence great caution is required.

Another form of ulcer arising from a special cause is the VARICOSE ULCER. This possesses the characters of a weak or indolent sore. It generally occurs on the legs, and always in connection with varicose veins. In these the blood accumulates, the circulation is retarded, and the proper nutrition of the limb is thus interfered with. Œdema takes place in the neighbourhood of the affected veins; this leads to undue

pressure, hence to loss of vitality, and at length to ulceration. In the first stage the ulcer so produced has a slightly raised margin. Its surface is brownish in colour and unhealthy in appearance, and its action is weak. Gradually the œdema increases, the infiltration becomes more solid, the limb becomes unshapely, and the sore assumes the appearance and character of a callous ulcer.

When we have to treat an ulcer of this kind, the patient should be placed in the recumbent posture and the limb slightly raised, so as to favour the venous return. Local support should be afforded by means of a bandage applied round the limb from the foot upwards, so as to aid the circulation and promote absorption. The ulcer should be treated by the application of black wash to the surface, and in some cases this may with advantage be preceded by the use of nitrate of silver. Under such treatment the sore will, in most cases, heal rapidly. The black lotion in particular seems to possess an almost specific action, but occasionally the chlorinated soda or chloride of zinc lotions may be used alternately with it. If the ulcer assumes an indolent form it should be treated in the manner already indicated for the cure of indolent sores.

After being healed, such ulcers are very liable to break out again, as the varicose condition which gives rise to them can seldom be completely remedied. The patient, therefore, should be warned of the danger, and instructed to wear an elastic stocking, either plain or laced —I generally prefer the latter—so as to give support to the returning column of blood. The special treatment of varix will be considered hereafter.

The PHAGEDENIC or SLOUGHING ULCER is characterised by the rapidly destructive nature of the process, and it forms the connecting link, as it were, between ulceration and mortification, so that it is sometimes spoken of as ulceration, at others as gangrene, as in the case of Hospital Sore or Hospital Gangrene.

Phagedenic ulceration presents itself under two forms, both equally dangerous, but differing in their local and constitutional symptoms. The more acute form, the BLACK PHAGEDÆNA, shows itself by the appearance of small vesications, containing a very dark serum, on the margins of some existing sore or wound ; or by some of the granulations in the centre of the sore suddenly assuming a deep purple or black colour, and by the purulent secretion from the surface becoming fœtid, altered in appearance, or altogether arrested. From the parts first affected by the dark vesication or black spot, the action quickly spreads, and the edges of the sore become black or purple and slightly everted. The neighbouring integuments assume a dark dusky red hue, without any circumscription, and either become tense and glazed, or else present a soft, boggy, and diffuse swelling. The granulating surface becomes affected and assumes the appearance of an ash-coloured or greenish, occasionally dark brownish-purple or black slough. The margins give way, enlarging the ulcer with extreme rapidity, and the black edges involve the neighbouring skin in the diseased action, so that in a few hours great destruction of tissue may occur. In some cases of black phagedenic chancre on the prepuce, the whole integument of the penis, and occasion-

ally even large portions of that organ, may slough in the course of twenty-four hours. As the ulceration or sloughing extends, some of the enlarged subcutaneous vessels may be opened into without time being given for hæmostatic changes, and very considerable loss of blood may occur. Occasionally, when this takes place, the surrounding tension and redness diminish, and the action is arrested for a time or altogether.

These local conditions are either preceded or accompanied by very marked constitutional symptoms of a febrile character, but these are rather of the irritative type, as in most inflammations of the erysipelatous form. There are rigors, violent headache, generally referred to the supra-orbital region, nausea, and occasionally vomiting of bilious or greenish-coloured matter. The tongue is foul and furred, with red edges, but dry and brown in the centre; and the pulse feels full and bounding, but after a short time becomes easily compressible. In the advanced stage we have perspirations, diarrhœa, and great prostration.

The other form of phagedæna presents different characters, both as regards the local appearances and the constitutional symptoms. From the appearance presented by the surface of the sore it has been named the Grey Pultaceous Phagedæna. It is more insidious in its mode of invasion than the black phagedæna, and as it is the form which most frequently attacks operation and other wounds, it is well to note its usual progress. The patient is out of sorts for a few days before anything is noticeable in the wound. He complains of chilliness, and want of sleep or disturbed sleep; moreover, the pulse is quick, the tongue foul, and there is loss of appetite. The edges of the wound or sore become infiltrated, swollen, and everted, and the surface appears as if covered with a soft granular deposit of a dirty grey colour. Soon after these appearances are observed, the limb or other part becomes swollen, often very tense, and of a light pink tinge, which is deeper at the margins of the sore: in some cases there is no redness at all, the swollen limb being of a pale yellow colour. The pulse now rises, varying from 100 to 130 or higher, weak and often irregular even at an early period, and the patient is feeble and irritable, and perspirations occur from time to time.

The local changes proceed very rapidly, the edges of the wound separate, the tissues appear as if infiltrated by the grey exudation, and hence the surface enlarges with great rapidity. I have seen a stump of the thigh, which was nearly healed, open up completely in less than two days after it was attacked with this form of diseased action. At the same time, however, this form of phagedæna does not seem to cause such a loss of substance as the black form; the skin seems to be rather pushed aside than destroyed, as I have seen stumps and large ulcers heal with very small cicatrices, after the action was arrested, although in some cases, when it attacked venereal buboes, I have known it produce great destruction of skin tissue. The constitutional symptoms are certainly characterised by greater debility than those which accompany black phagedæna.

The causes which lead to this formidable disease are generally either endemic or epidemic. Occasionally we meet with sporadic cases, depending on some unhealthy tendency in the individual, want of clean-

liness, the use of improper irritating dressings, or a combination of all these conditions; but by far the largest number and best-marked cases arise either from endemic or epidemic influences.

Examples of endemic causes, or those which originate and are developed in some particular locality, are those where the atmosphere pervading a house, hospital, or district, is contaminated by the effluvia due to bad sewage and bad ventilation, or the gradually acumulating vitiated air in rooms or wards where several patients are more or less constantly confined, as in large hospitals, especially where there are many surgical cases under treatment. Indeed, so generally is this last example of endemic influence recognised, that phagedæna is often denominated hospital sore, or hospital gangrene. As an epidemic, phagedæna occurs very generally at seasons when erysipelas, scarlatina, and diphtheria prevail. These causes should be carefully kept in mind, both in regard to prophylaxis and treatment.

The epidemic causes not being under our control, a knowledge of them is chiefly of use in guarding us against performing any operation we can possibly avoid during the prevalence of any of the epidemics alluded to. But with reference to the effects of irritating dressings, or the endemic influences, these, being greatly under the control of the surgeon, should be very carefully attended to, so that they may be diminished or altogether obviated. Thus the most scrupulous cleanliness should be insisted upon, and hence all old dressings must be removed and burned. The use of sponges to wash sores or wounds should in no case be allowed, tow being used instead, and then committed to the flames after the dressing is completed. Dressings should be light and unirritating, and in warm weather they should be sprinkled with some antiseptic fluid.

In hospitals, or other places temporarily used as hospitals, overcrowding the wards should be prevented, and sufficiency of air be thus obtained for each patient.

Great attention should be given to proper drainage and ventilation. The latter is best accomplished by natural means, such as windows and open fireplaces. Mechanical methods of ventilation—such as heated shafts for extracting the foul air—are almost always disappointing, their success being usually in the inverse ratio to the amount of ingenuity displayed in the arrangements and the complexity of the apparatus. I had the misfortune to experience this in my own hospital practice shortly after I took charge of the Senior Surgeon's wards in the Surgical Hospital. These had only been in use for about three years, and had been arranged as model wards, and ventilated on the purest and most approved scientific principles. Notwithstanding this, it had been noticed that cases did not go on so favourably as in less favoured localities; and two or three weeks after I had removed my patients into these wards, first some stumps, which were nearly healed, took on an unhealthy action, and soon all sores and wounds presented the characters of either the black or grey phagedæna. The slightest abrasion or cut was infallibly attacked by the diseased action, which was most intractable. The patients were removed to a small reserve hospital on the grounds, occasionally used as a fever-house; and

though not perhaps a model hospital, the change of locality acted like magic on the patients. The sores began to amend almost from the time of the removal; and ultimately every patient who had been removed made a good recovery. Indeed the only two fatal cases occurred at the commencement of the outbreak, and these were originally amongst the most trivial wounds—one a case of simple fracture of the thigh, with slight abrasion over the knee. The case had been under treatment about a fortnight when the abrasion presented the appearance of black phagedæna, and resisted all treatment. In the other fatal case, the phagedenic action followed upon an incision of the prepuce, for phymosis, in a man of worn-out constitution. Careful investigation showed how very imperfect the removal of the vitiated air must have been. And now that natural ventilation by the windows and air-chambers, by the ventilator in the roof, and open fireplaces, has been adopted, and other changes made in the arrangement of the wards, I have not for many years seen phagedenic sores unless when brought into the house from without, or occasionally when unhealthy tendencies prevailed generally in the city and neighbourhood as epidemics.

I think it right, however, to express my opinion that we must not trust implicitly even to the best arranged and ventilated wards, to the exclusion of other precautions. I have noticed that the best wards are not unfrequently those in which unhealthy conditions manifest themselves; and the cause is not far to seek. Being the best, they are the wards in which, for obvious reasons, we place our operation and other important cases, and after a time our favourite ward becomes the scene of some unexpected unhealthy condition. We must remember that many of the causes of the vitiation of hospital wards are cumulative, and hence I have for many years been in the habit of clearing out a ward at short intervals, if only for a few days, and having it washed and thoroughly fumigated, either with chlorine or sulphurous acid fumes, and then all the windows kept open for thorough ventilation; and from experience I can strongly recommend the general adoption of this plan.

The treatment of phagedæna naturally divides itself into the local and general, and requires to be modified according to which of the two forms the disease assumes.

The local treatment in both forms consists in destroying the diseased surface, and then using antiseptic applications with the view of preventing the spread of the action. This indication is effected by the use of strong caustics, such as nitric or sulphuric acid, or even the actual cautery. I have tried all of these, and found the cautery to be generally followed by the rapid extension of the disease, so that I abandoned it, and used the mineral acids as better suited for the purpose, their destructive action being more limited, the effects of the cautery apparently diminishing vitality in the surrounding tissues. In the grey phagedæna, or in ordinary foul sores, I prefer the application of a saturated solution of chloride of zinc, applied as a caustic, and this also acts as a powerful antiseptic. In both forms of the disease I have found that wood charcoal poultices answered better than almost any other antiseptic remedy in deodorising and promoting a healthy action in the sores. But in many cases I have seen great advantage from the use of

carbolic acid paste applied to sores of a phagedenic character, and followed by the use of a dilute watery solution in warm-water dressing.

The extensive inflammatory redness and tension in cases of black phagedæna, and the benefit which sometimes occurs from accidental hæmorrhage in such cases, might lead us to expect benefit from incisions; and some have even recommended this, but the risk of the incisions becoming new centres of diseased action has always deterred me from venturing to try it, and I believe we can relieve the local inflammation with less risk by constitutional remedies, such as antimonials and opium.

It is in the general treatment of the two different forms of phagedæna that we require to exercise the greatest discrimination. In black phagedæna there is, in the earlier stages at least, violent local action, and hence we require to exhibit small doses of antimony with opium, or minute doses of belladonna or aconite, giving, at the same time, farinaceous and milk diet when the patient can digest this, and as far as possible avoiding wine or other stimulants; but at the same time we must recollect that by and by the blood-poisoning will induce typhoid symptoms, so that we must not carry the antiphlogistic treatment too far. In the latter stages of the black phagedæna, and from the first in the grey form, great benefit will be found to accrue from the use of tincture of muriate of iron or the sulphate of quinine, after the digestive organs have been attended to. The diet also must be more generous than in the early stages of black phagedæna. In many cases opium requires to be exhibited largely, and seems less productive of bad consequences, or interference with the digestive organs, than under ordinary circumstances.

When the disease appears as a result of endemic causes, as in hospital practice, no treatment can be expected to be of use so long as the originating cause is in operation. The patients must, as soon as possible, be removed elsewhere, to tents, or sheds, or any accommodation that can be obtained, till the wards are thoroughly cleaned and ventilated.

LECTURE X.

Mortification or Gangrene: its Phenomena, Causes, and Varieties—Acute or Humid Gangrene: its Symptoms and Manifestations—Treatment must be regulated according to the Cause—Question of Amputation in Traumatic Gangrene.

MORTIFICATION or GANGRENE is complete and extensive death of a part. It may result from inflammation, or from injury. As a result of inflammation, it may be due to the amount of the inflammatory infiltration and the rapidity with which it is poured out. The pressure which this exerts on the textures interrupts nutrition, whilst, at the same time, some of the engorged capillaries or minute bloodvessels may rupture, thus leading to extravasation of blood into the cellular tissue, and further interference with the nutrition and the vitality of the part. The blood, exudation, and surrounding tissues, become disorganised; they undergo decomposition, gases are evolved from them, and alteration in colour takes place under the integument. If the skin be not broken, infiltration of the gases into the surrounding cellular tissue occurs; further discoloration takes place; and the blood-poisoning resulting from these local changes hastens the progress of the constitutional symptoms.

The causes of Gangrene may be considered under three heads—(1) those which destroy directly the vitality of the textures; (2) those which interrupt the flow of blood through the part; (3) impaired innervation of the part. Under the first head we include mechanical injury to the part, pressure over bony prominences, extremes of cold or heat, escharotics, and, lastly, poisonous or infective matters acting upon the textures, either directly or through the medium of the circulation. Under the second head we recognise all causes which lead to obstruction in the capillaries, veins, or arteries, as well as slackening of the circulation from cardiac weakness. The capillaries may be obstructed by the pressure exercised upon them by inflammatory products or hæmorrhages. In this case the gangrene is most liable to occur in dense tissues possessing a low vitality. Obstruction in the arteries may be the result of emboli, disease of their coats, a ligature, or the spasmodic contraction of the minute arteries from the continued use of rye-bread containing ergot. Gangrene depending upon venous obstruction pure and simple is of rare occurrence, but is seen in certain forms of chronic senile gangrene, and these are characterised by great engorgement of the veins of the part. More commonly we find the gangrene resulting from a combination of arterial and venous obstruction, and of this there are many examples—viz. the sloughing of the glans penis, which sometimes occurs in phymosis; the death of a limb from irregular and tight

MORTIFICATION

Plate III

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

bandaging, as seen in the accompanying woodcut (fig. 11); and the mortification which the bowel undergoes in cases of strangulated hernia. Cardiac weakness is not a common cause of gangrene. It may be due to excessive debility or fatty degeneration of the heart, and we generally find that, in this case, the gangrene takes place in parts far removed from the centre of the circulation, and it is partial. The third cause of gangrene—viz. impaired innervation—may arise from division of some important nervous trunk, or from some interruption of the proper performance of the functions of the nerves. Gangrene does not always take place, however, in these cases, and when it does it is almost always of a chronic and partial character.

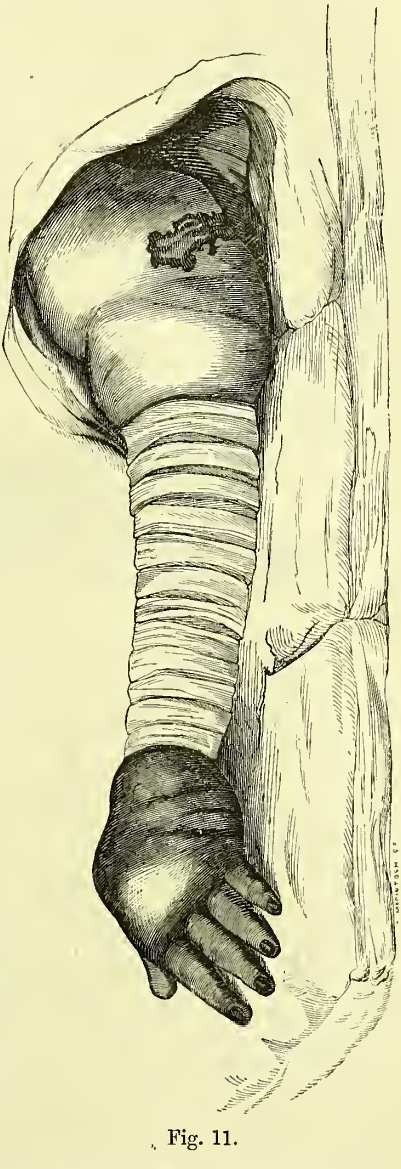

Fig. 11.

Gangrene or mortification is classified under two principal forms—the *Acute*, humid, or traumatic gangrene, and *Chronic*, or dry gangrene. In the acute form the action proceeds very rapidly, and the fluids have not time to pass out of the textures before their death. In the chronic form the gangrene supervenes slowly, and is not always or generally attended, either by the same violent local action, or by the same severe constitutional disturbance.

The best example of the Acute or Humid Gangrene is that which results from injuries. Extravasation of blood takes place, possibly from rupture of some of the more important vessels at the moment of the injury. Inflammation sets in; inflammatory infiltration and serous effusion are poured out, giving rise to increased swelling and tension, by which the circulation is impeded. In traumatic gangrene of the leg, the limb appears somewhat swollen and of a purplish or mottled colour; at first its temperature is slightly raised, afterwards, however, it falls, and the foot assumes a livid appearance. A peculiar inflammatory action begins on the proximal side of the injured part; at the same time the seat of injury becomes very dark, and the parts distal

to it assume a dark purple, grey, or ash-coloured appearance. At and beyond the injured part vesications occur, filled with a dark-coloured fluid (*phlyctenæ*). When a certain amount of inflammatory action precedes, these phlyctenæ are well marked; but when the vitality of the part has been very rapidly destroyed after reaction, the vesications are not so well seen. They depend on the separation of the cuticle, and the effusion of dark-coloured serum between it and the true skin, and therefore they are not well marked if the integument has been much lacerated, for then the fluid escapes. When the disease progresses very rapidly this separation of the cuticle does not take place; the parts directly injured become dark and dead, and emit a peculiar fœtid odour, whilst those beyond retain a certain degree of vitality. The neighbouring parts have a peculiar puffy appearance, and on pressure there is a feeling of crepitation, owing to the emphysema—that is, the presence of gas in the cellular tissue. The swelling is the result partly of infiltration, partly of the extrication of gases (fig. 12).

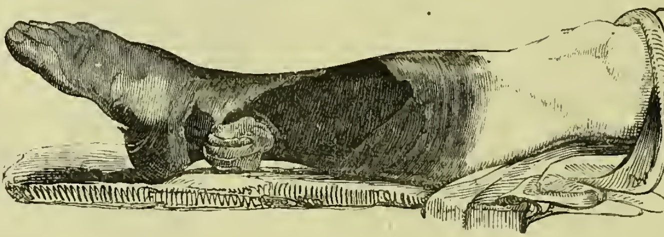

Fig. 12.

When the gangrene ceases to extend, a line of demarcation is formed between the dead and the living tissues; this line becomes a deep furrow, which slowly separates the completely dead from the living parts.

Along with these local symptoms of acute gangrene, we have certain constitutional symptoms. The irritative fever which is set up varies in its intensity. In the first stage of reaction, after an injury terminating in gangrene, the pulse rises, the skin becomes hot and feverish, the tongue foul but not dry, still, however, with a tendency to become dry at the back part. The pulse very soon loses its fulness and force; in most cases it becomes soft. The fever becomes typhoid, and then delirium sets in. Delirium shows itself first by a tendency to wandering at night, and then it becomes constant and more violent in character. This form of delirium is that known as *delirium traumaticum*. Next, the tongue becomes dry, the pulse more frequent, small and compressible, the features sharp and of a leaden hue, the eyes sunken; irregular cold clammy sweats set in, at first partial, then over the whole body, and the patient is in a semi-comatose state. There is vomiting and hiccup—the latter being a very marked condition, especially in hernia when part of the bowel becomes gangrenous. Such are the general symptoms of acute gangrene.

The local phenomena are due either to sudden disintegration of the parts; or the interruption of the circulation by the violence of the injury; or, more slowly, to the inflammatory action which results, the

part being so debilitated that it cannot resist destruction when inflammation sets in.

The grey appearance is that which first results in the decomposition of tissues containing little or no blood. The black appearance is, in the first instance, due to a deoxidation of the colouring matter of the blood, or to special compounds formed by the action of the liberated gases upon it, and finally to its complete decomposition and that of the tissues. The constitutional symptoms may be due to a form of blood-poisoning, the result of absorption by the vessels either of the poisonous gases which come off, and which do not get free vent externally, or of the putrid fluids.

The constitutional symptoms in traumatic gangrene are not always proportionately intense to the violence of the injury or the complete death of the part. Very much depends on the health of the patient. If the constitution be good, and the cause of the gangrene be distinctly local—that is to say, if the violence of the injury is quite sufficient to account for destruction of vitality in the injured structures—these symptoms may at first be very slight, as was the case in this gangrene of the hand (pl. iii. fig. 1). But if the patient be of a weak constitution, the gangrene which sets in after an injury will have all the constitutional symptoms in great intensity, because there is, as it were, a constitution ready to be affected by a comparatively slight cause. Hence, when the marked constitutional symptoms come on after a comparatively slight injury, we may infer that the constitution in such a case was debilitated.

Another condition affecting the intensity of the constitutional symptoms is the importance of the part injured. Sometimes a large slough separates without much harm being done, as when a fascia sloughs. But if the gangrene be in an important texture, such as a portion of bowel, even though only a small part of it be affected, all the constitutional symptoms come on in a most intense form.

As I have told you, acute gangrene may be due to injury. The injury alone may be so violent as to destroy the part, or it may be less severe, and an unhealthy condition of the system may determine gangrene instead of healthy action. Acute gangrene of a very intense form may also result from extravasation of acrid fluids, such as urine, into the cellular tissue or into certain organs. In extravasation of urine in cases of stricture, the whole textures die in the course of a very few hours. From almost the first there are marked and intense constitutional symptoms—pulse weak, wandering, and then violent delirium; the debility and irritative fever proceed very rapidly, though only a small amount of fluid be extravasated. These symptoms of urinary infiltration are just the symptoms of gangrene, combined with those of uræmia.

The *Treatment* of acute gangrene must depend greatly on the cause. If the cause be constriction of the tissues, as in hernia, the main indication is evidently to relieve the constriction. In a case where gangrene is imminent, from tight bandaging, of course remove the bandage, and then, if necessary, make incisions so as to relieve the tension, get rid of the sloughs, allow the escape of the gases which may have been formed,

and so give a chance of recovery. After the incisions, apply lint soaked in charcoal and warm water or charcoal poultices to the part affected.

In extravasation of urine it would do no good to pass a catheter and draw off the urine; it would certainly prevent further extravasation, but it would not affect the textures injured by the urine already extravasated. The treatment is obviously to make free incisions in the scrotum and perineum, or other part, in order to allow the extravasated urine and sloughs to escape.

In cases of gangrene, generally, where there is any tension, we make incisions into the part to allow the exudation and gases to escape. And by making free cuts through the slough we do good, because it often forms a sort of mechanical barrier to the escape of the putrid fluids and gases below it.

In cases of acute gangrene we must be very cautious about giving stimulants at first. When the patient is weak, however, we require to give them in small but gradually increasing quantities, as well as opiates and nourishing diet. Ammonia may also be given in extreme cases to stimulate the patient, but not in cases of urinary infiltration, for it tends to favour decomposition of the urine. During the irritative fever we must avoid over-stimulation, which might excite the gangrenous process to greater activity; and therefore we give nourishing but not very stimulating diet—such as farinaceous with a little animal food. The excretions must of course be attended to.

As regards the question of Amputation in Traumatic Gangrene, it is clear that in cases of acute gangrene, where the violence of the injury has been of such a kind as to account for the loss of vitality of the part, there can be no hesitation as to the propriety of the operation. Where the part is quite gangrenous we should amputate at once, before constitutional symptoms have set in, because if we leave it alone the gangrene will certainly spread, and irritative fever from absorption of septic matter supervene; or if we wait for nature to form a line of demarcation, the patient's strength will be worn out, and we will have to amputate much higher up the limb than would have been necessary if we had performed the operation earlier. In this case there is no advantage in postponing the operation, as the part is past recovery, and the sooner it is got rid of the better. Should, however, the history of the case, the nature of the injury, and the constitutional conditions, lead us to suspect that the gangrene does not entirely depend on the injury, the question of amputation becomes more difficult. The case is unfavourable in any way; still if, after making free incisions to relieve tension and allow the gases and fluids to escape, and the use of antiseptic applications, the gangrene continue to spread, the safest plan is to amputate early, without waiting for a line of demarcation. Even when the gangrene is spreading I believe the best chance for the patient is to amputate, but in doing so we must cut very wide of the apparently diseased textures.

LECTURE XI.

Chronic or Dry Gangrene: its Causes and Treatment—Senile Gangrene of Pott: Treatment—Gangrene arising from Ligature of a Vessel—General Recapitulation of the Question of Amputation in the different forms of Gangrene.

Chronic Gangrene is generally, though not always, dry. The constitutional causes may be temporary or persistent. Temporary causes are frequently seen after scarlet or typhus fever, when there is a tendency to form bed-sores. These are patches of gangrene formed over the buttock or other part upon which the patient has lain long; the gangrene is due to pressure and the diminished vital power. Chronic gangrene of the toes and feet often arises from the febrile excitement and debility consequent upon fever, and here, the cause being only temporary, the constitutional symptoms do not manifest themselves if proper treatment be adopted. In chronic gangrene resulting from constitutional causes of a temporary character, the local treatment is limited to applying a poultice, not too warm, to the part, or keeping it wrapped up in cotton wadding so as to preserve its temperature, and avoiding any external stimulation, in case it should hurry on the diseased action. As regards the constitutional conditions, tonic remedies are to be used. After a line of demarcation has formed, and when the patient's strength is so far restored, amputation of the diseased part should be performed, but higher up the limb than the line of demarcation, so as to form a good stump.

The constitutional causes may, however, be persistent, and then they are very different from the temporary causes. In some cases embolism is the cause. The term embolism signifies the plugging and consequent occlusion of vessels by clots of blood or small masses of fibrin carried into the smaller vessels. Or there may be some inflammatory affection of the coats of the bloodvessels, leading to their occlusion. In these cases the irritative fever is very marked. The Irritable form of chronic gangrene arises from obstruction of the capillaries, and is of this kind. It is attended by a good deal of local inflammatory action; some of the fluids are retained in the dead part, and there is constitutional disturbance.

The constitutional symptoms are often absent or slight in chronic gangrene arising from persistent causes; but the gangrene has a tendency to spread; so that we cannot operate in such cases, because we do not know where the cause—the obstruction of the vessel—may be.

There is another form of chronic gangrene, in which the parts be-

come dry and shrivelled, and where there is comparatively little of the local irritability that exists in the irritable chronic gangrene (plate iii. fig. 2.) The disease begins in one finger or toe, and spreads from it to the others. The parts dry, give off all their fluids, and shrivel up. There is thus less chance of blood-poisoning, and the constitution suffers very little; and sometimes only slight pain is experienced. The change seems to take place so slowly that the fluids are expelled before the death of the part, and thus less rapid disintegration occurs and there is less constitutional disturbance. This variety of chronic gangrene often arises in old persons of a gouty or rheumatic diathesis, and is usually termed *Dry Senile Gangrene.*

The constitutional *Treatment* is here very slight. If the patient cannot sleep, opiates are to be given, along with nutritious and perhaps slightly stimulant diet, because there is no over-action of the diseased part; but beware of too much stimulation, lest you excite over-action in the dying part. The local treatment consists in wrapping the limb in cotton wadding, and placing it so as to favour the circulation. We must not apply any local stimulus, such as heat or stimulating liniments, to the part, as we might thereby bring on a more irritable action. All pressure on the limb is to be avoided, and it should be placed on a water-pillow.

The Senile Gangrene of Pott is that irritable form of chronic gangrene in which there is violent local action, with diminished vital power, and an irritable state of the system.. The patient may be somewhat plethoric, and used to free living, and then a very slight exciting cause may lead to the gangrene. This form of gangrene generally attacks the foot (plate iii. fig. 4). It commences not unlike the dry senile gangrene, but it is always attended with a considerable amount of local excited action in the vicinity of the gangrene. There is redness, swelling and puffiness from the exudation, and on the dorsum of the foot there is a great deal of weak inflammation—*inflammatio debilis,* as it is called. The general constitution may sympathise; the pulse becomes quick, the skin hot and dry, the tongue foul, and the urine scanty. There is intense pain in the part affected and sleeplessness at night, also a throbbing feeling in the whole limb, and all the symptoms of irritative fever.

The *Treatment* was formerly based on the idea that the disease was due to debility, and that the patient therefore required great stimulation; thus strong soups were given with much animal food, brandy and strong wines, and large quantities of powdered Peruvian bark as an antiseptic. The effect of all this was to over-stimulate the patient, impair the digestive organs, and thereby cause the local disease to extend with great rapidity—almost as rapidly as acute traumatic gangrene. All this arose from the treatment. Mr. Pott was the first to point out that the disease was one of irritability, and not altogether of debility, and that the use of stimulants was therefore wrong and led to over-stimulation of the weak part, and to greater rapidity in the progress of the gangrene after it had set in. He showed that nothing should be done to stimulate the part or the constitution.

The proper course is to allay the irritability by the use of opiates

internally, and to avoid all over-stimulation of the patient by giving simply enough food for nourishment, and this of a kind easily digested —such as farinaceous food and milk. In this disease opiates are not found to interfere so much with the digestive organs as they usually do. No bark should be given, at least not in the earlier stages.

The local treatment used to consist in scarification and the application of hot dressings and stimulating ointments, to excite the part and hasten the separation of the sloughs and gangrenous parts. This generally had the effect of increasing the gangrene.

The local treatment adopted and recommended by Pott was very different. He wrapped the parts affected, and indeed the greater part of the limb, in cotton wadding, so as to maintain the temperature, and as much as possible to avoid pressure on the limb and favour the circulation in it; but he avoided all stimulants, either local or general. This is the true principle of treatment, and it is found to be much more successful than the former plan of stimulation, by which the disease was quickened and induced to spread. Under non-stimulating treatment the gangrene generally ceases, a line of demarcation forms sooner, and thus there is a greater chance of recovery. The patient may be so weak, however, that stimulants are absolutely required, but experience must guide us in deciding in special cases.

As to amputation in constitutional gangrene.—In cases arising from a temporary constitutional cause, such as that occurring after a fever, we amputate above nature's line of demarcation. But where the constitutional causes are persistent we should not amputate at all; even after a line of demarcation has formed we should not interfere, beyond dividing through dead textures to remove the fœtid mass, and diminish the risk of absorption of septic matter. We should let nature form a stump of her own. Interference only renders the gangrene irritable, and causes it to spread more rapidly. We cannot tell how far the vascular system is affected in such cases, and very little local irritation will set up diseased action afresh. When the cause is embolism, or arrestment of the circulation from inflammation of a vessel, we may after a time amputate; but we must wait until we are able to determine the site of the obstruction.

The best example of chronic gangrene arising from a Local and Temporary cause, is that resulting from cold (plate iii. fig. 3). In such a case we cannot tell how far the cold has affected the limb. This cause is generally in operation along with others, such as want of food, or other great hardships. This form of chronic gangrene is not attended by very great constitutional disturbance. The part seems simply affected by depression of the circulation from the cold. After reaction, the effusion which takes place gives rise to still further obstruction of the circulation, and death of the part follows. It is generally the feet or hands that are thus affected.

The treatment consists in giving the patient nutritious diet, cautiously avoiding stimulation, and wrapping the limb in wadding; or applying a charcoal-poultice; or lint soaked in water and charcoal, not much above the temperature of the sound part of the limb, may be applied to prevent fœtor and favour separation of the dead parts. In cases of

this kind amputation should ultimately be preformed; but we must wait until the line of demarcation is thoroughly formed before doing so, for we cannot otherwise tell how far the cold has exercised its fatal influence. I remember a case of gangrene arising from cold—(plate iii. fig. 3)—in which a deep line of demarcation formed on the dorsum of the foot, but not on the sole. Amputation through the tarsus was about to be performed, when suddenly the gangrene, which seemed to have ceased, attacked the heel, and spread from that to the front of the foot, and not for some time afterwards was there a complete line of demarcation formed above the ankle, so that amputation could be performed through the leg. Remember, then, that in such cases there is a tendency to the gangrene recommencing, and wait till complete demarcation takes place.

A peculiar sub-acute form of gangrene sometimes results after ligature of a vessel, such as the superficial femoral artery in cases of popliteal aneurism. The gangrene may supervene in the foot; there is not as a rule much constitutional disturbance, although in some cases there is more than in ordinary chronic gangrene. The local disease sometimes spreads rapidly, extending even above the seat of ligature if allowed to proceed. In this class of cases we at first employ the ordinary treatment for chronic gangrene: maintain the temperature of the limb, prevent pressure on it, and support the patient's strength. In this form of gangrene, however, we know where the point of obstruction to the circulation is, and therefore when the gangrene spreads, and we see that amputation must be performed sooner or later, we should do it at once. We should not, however, amputate below the knee in gangrene after ligature of the femoral for popliteal aneurism, even although a line of demarcation appears, because the diseased condition which rendered the ligature necessary still exists, and there is a great tendency in the gangrene to spread up to the knee.

Some surgeons say that we should amputate above the ligature—at the trochanters, or at the hip; but there is no necessity for this. If the gangrene has not passed the knee we need not go higher than the middle third of the thigh, or even the lower third. The obstructed vessel chiefly supplies the leg and foot, and there is still sufficient vascular supply left for the thigh by the deep femoral and other arteries. In gangrene arising from ligature of the femoral artery, we should therefore amputate, but not below the knee, nor above the middle third of the thigh, unless the disease has spread higher up before the operation.

I shall conclude this subject by giving a general recapitulation of the rules for amputation in different forms of gangrene.

1*st.* In traumatic gangrene, where the violence of the injury is sufficient to account for the destruction and loss of vitality of the parts, amputate at once, and not necessarily very high up.

2*d.* In traumatic spreading gangrene, where the original injury was not sufficiently severe to account for the gangrene, and where we therefore suspect that the constitution, or some debilitating cause is co-operating with the injury, and where the gangrene is spreading, amputate without waiting for a line of demarcation. It is not a favourable case, but the

best chance of recovery is given by early amputation. In this case amputate very wide of the gangrene.

3d. In chronic gangrene, arising from constitutional causes of a temporary character, wait till the general health is re-established and a line of demarcation thoroughly formed, and then amputate higher up to make a good stump.

4th. In gangrene resulting from cold the same rule applies.

5th. In grangrene resulting from constitutional causes of a persistent character, do not amputate at all—let nature form the stump—do no more than cut through dead textures.

6th. In gangrene after ligature of the main vessel of a limb, if the gangrene be decided and is spreading, amputate at once. If the superficial femoral artery has been tied, amputate at the lower third of the thigh, for the branches of the profunda and their anastomoses are quite sufficient to nourish the parts forming the stump. In some cases of spreading gangrene resulting from embolism this rule may also be applied if we come to a satisfactory conclusion as to the site of the obstruction.

LECTURE XII.

Erysipelas: its Symptoms and Appearances—Idiopathic and Traumatic Erysipelas—Distinction between Erysipelas and Phlegmon—Erythema—Bilious Erysipelas Phlegmonous Erysipelas—Œdematous Erysipelas—Erysipelas of Head and Face: Origin, Termination, and Prognosis—Treatment.

Erysipelas is a peculiar inflammation of the cutaneous structure. It is a disease the knowledge of which is of great importance to the surgeon, for in certain states of the constitution, and under certain circumstances, as when it prevails epidemically, we find it thwarting his best-designed operations, and converting the most trifling into serious injuries. Erysipelas may attack any part of the surface, and the general appearances and characters of the inflammatory action and its termination are modified by the nature of the part in which it occurs.

In those forms of the disease where the inflammation is limited to the skin, it is characterised by bright redness of a lake tinge. This redness is not circumscribed but diffuse, the colour gradually fading into that of the surrounding skin (plate iv. figs. 1 and 2). On pressing the part with the point of the finger, it becomes pale, the cutaneous capillaries being for the moment emptied by the pressure, but as soon as this is withdrawn they immediately refill, and the redness again returns. There is little or no tension in the part, and the pain is of an itching and burning character. As the capillaries cannot relieve themselves by effusion into the skin tissue, the serum is exuded between the true skin and cuticle, causing vesications. Where the inflammation of the skin is in the neighbourhood of parts containing much loose cellular tissue, into which the vessels can relieve themselves by effusion,—there is often a great amount of infiltration or serous effusion into the cellular structure, and the surface in these cases pits on pressure.

Erysipelas may be either *idiopathic* or *traumatic*. The former arises from some epidemic or constitutional cause, and the latter results from some external wound or injury. Generally, however, there are evidences of constitutional disturbance prior to the appearance of the cutaneous affection; so the probability is that, even when it supervenes upon, or seems to be induced by, an external injury, some constitutional exciting cause must be at the same time in operation. The premonitory symptoms, too, are alike, whether the cause be idiopathic or traumatic; they consist generally of chilliness, rigors, nausea, headache, and not unfrequently an attack of vomiting or diarrhœa.

The distinguishing marks between erysipelas and pure phlegmon are, that in erysipelas the inflammation is more diffuse and tends to spread over the surrounding surface, whereas in phlegmon it is limited to the

Fig. 1

Fig. 2.

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part where it began, which portion only becomes swollen. But the best diagnostic mark, perhaps, is that phlegmon is always defined by a hardened boundary, from the effusion of coagulable lymph into the surrounding cellular tissue, whilst in erysipelas the swelling is diffuse.

The inflammatory action in erysipelas being confined to the skin, swelling cannot occur to any great extent, but effusion takes place beneath the cuticle and puffs it up into small vesications. When the inflammation of the skin begins to subside, soft swelling often takes place, in consequence of the vessels of the part relieving themselves by effusion into the subjacent cellular tissue. A very constant and characteristic symptom of erysipelas is a tendency to wandering and delirium at night; this often occurs even in the slightest cases.

So much for the general characters of erysipelas; but as it presents itself in a greater variety of circumstances and conditions, it is necessary that we should examine these states more particularly. The disease was formerly divided into several different species, according to the symptoms or terminations of the inflammatory action. But we will simplify the subject, without losing anything of practical utility, by considering it under the several heads of ERYTHEMA—*Bilious*—*Phlegmonous*, and *Œdematous* ERYSIPELAS.

By the term ERYTHEMA is understood that form of the disease which consists in mere redness or erysipelatous blush of the skin, followed by efflorescence without swelling or vesication, and accompanied in general by only very slight constitutional disturbance or fever. It is attended with a sensation of heat, which hardly amounts to pain, and it generally terminates in resolution. In some cases, however, the appearance of this erythematic blush after an operation, and more especially if it assumes the erratic form (*erythema erratica*), is indicative of serious mischief, and therefore ought not to be disregarded. In these cases the pulse becomes very quick, the tongue furred, and there exists a great tendency to the occurrence of typhoid symptoms. The erythema passes from the skin to the mucous surfaces; chiefly to the mucous membranes of the air-passages and intestines. It rarely passes from the scrotum or penis to the mucous membrane of the urethra, bladder, or kidney. In one case, in which I had removed the breast, it passed to the lungs, giving rise to broncho-pneumonia. When the pulmonary symptoms ceased, erythema occurred in the thigh, and thence travelled up to the breast on the opposite side to that removed, but it never appeared near the wound itself. Afterwards it passed to the mucous membrane of the bowels, giving rise to acute dysentery. Ultimately the patient recovered. This case illustrates the metastatic tendency of the disease. Though it appears to be a trifling affection, yet it is really a very serious one; it is a pure blood-disease, and is attended with considerable danger.

BILIOUS ERYSIPELAS is ushered in with rigors. The colour of the affected skin is rather of an orange than a lake red, the tongue becomes foul, furred, and of a brownish-yellow colour; the eyes are dull and yellowish; and there are more signs of derangement of the digestive organs than in other forms of the disease. The cutaneous inflammation is preceded by a bitter foul taste in the mouth, nausea, and vomiting.

PHLEGMONOUS ERYSIPELAS is a much more violent form of the

disease, both in its local and constitutional symptoms, and can scarcely be regarded as being merely inflammation of the skin, for it extends into and involves the cellular tissue, and also the fascia. The swelling is more deeply seated and extensive than in any of the other forms. The pain also is more intense, and is of a throbbing burning character. The skin usually assumes a dark red hue, and there is great tension of the affected parts. The pulse rises in frequency to about 120; the general surface becomes hot and dry; the tongue becomes dark in colour, and parched on the surface, with the tip and edges reddened and glazed; the secretions are arrested; there is want of sleep at night, and often acute delirium—all the symptoms, in fact, of severe irritative fever; but the sickness and foul taste in the mouth do not usually come on until the violence of the disease begins to subside.

Œdematous Erysipelas may simply result from the cutaneous vessels relieving themselves by serous effusion into the loose cellular tissue, where that tissue is abundant, or it may occur in old or debilitated patients, when the symptoms in general are those of a weak inflammatory œdematous state of the lower limbs. Again we frequently find erysipelas supervening on anasarca, and then the parts involved assume this form of the disease. In such cases we have always a considerable degree of debility, complicated with low irritative fever, and this condition must never be lost sight of in the treatment.

Erysipelas of the head and face is a condition which is marked by very characteristic appearances (plate iv. fig. 1). The scalp becomes red, tense, and painful, but there is little swelling owing to the density of the scalp tissues; when, however, it spreads to the face, where there is great vascularity and abundance of loose cellular tissue, a great degree of swelling and consequent deformity rapidly take place. The fine cellular tissue of the eyelids becomes infiltrated, congested, and distended, so as to close up the eyes. The cheeks, lips, forehead, and parts over and under the jaw, next become swollen in succession. The action of the muscles of expression is both interfered with and obscured by the swelling, so that the whole countenance assumes a passive stolid expression, or rather want of expression. The tendency to wandering and delirium at night, so characteristic of erysipelas in all its forms, is especially well marked when the head and face are affected.

The causes of erysipelas may be epidemic, local, or constitutional. The disease may arise locally from injury, or from improper, foul, or rancid dressings to wounds or sores; but probably, in almost every case, it is more or less dependent upon some predisposing cause, either epidemic or constitutional.

It occurs most frequently in those who live freely, and indulge in the abuse of spirituous liquors. It is sometimes caused by mental emotions, which give rise to disturbance of the physical condition of the body. It may also arise from exposure to extremes of cold or heat. The latter is a very frequent cause; and to this we may perhaps attribute the frequency with which erysipelas of the head and face attacks cooks and others whose occupations expose them to constant high temperatures; perhaps, also, somewhat to their habits.

In certain states of the atmosphere erysipelas prevails very generally

—most usually during the spring and autumn months. It has been remarked that puerperal fever and scarlatina often prevail at the same time; and this, taken with the fact that attendance on one may communicate the other, inclines me to believe that a strong analogy exists between these diseases; and midwifery practitioners are properly very cautious of attending on erysipelatous diseases.

Of the terminations of erysipelas the most desirable is resolution. When this takes place the redness gradually fades, the swelling subsides, the vesicles disappear, absorption progresses, the skin becomes shrivelled, and the cuticle speedily desquamates; the constitutional symptoms disappear. Thereafter the parts gradually resume their wonted character and appearance.

When the inflammation has extended to the cellular tissue underlying the skin, it may terminate in suppuration. Circumscribed abscess in erysipelas is by no means a rare termination, although it has been stated that it seldom or never occurs. I have seen it take place in the scalp, eyelids, hand, and arm, and it is not unfrequent in the lower extremities. Very generally, however, the collections of matter are more diffuse, as there is little tendency to plastic exudation in the disease. In phlegmonous erysipelas the pus is thin, acrid, and of an unhealthy sanious character. It becomes extensively infiltrated throughout the cellular tissue of the part, dissecting the muscles, and separating the adjacent textures, in which it often leads to sloughing. During suppuration the overlying integument assumes a dark brownish colour, and imparts to the touch a feeling of soft boggy fluctuation. This condition has received the name of cellular infiltration; it is rather diffuse infiltrated suppuration, the result of phlegmonous erysipelas.

Prognosis in this disease must be based upon the constitutional condition and symptoms. It must be in all cases very guarded, for the most serious cases are often trifling and slight in their primary manifestations. It must be regulated partly by the history of the patient's previous habits as regards intemperance, and by his present state as regards age and debility, together with the character of the attack—whether acute or typhoid—its symptoms, and its site. In cases where the disease is situated on the head, and attended with great cerebral excitement; or in the air-passages, and attended with dyspnœa; or when it attacks the surface of the abdomen, and dysenteric symptoms supervene, the danger is very great. So is it also in all cases of extensive phlegmonous erysipelas, especially when attended with sloughing and discharge. Finally, in any case, if the pulse keeps high—above 100 for more than ten days—the prognosis is unfavourable.

The Treatment should, as a general rule, be antiphlogistic, but with certain reservations; thus we must modify our antiphlogistic treatment according to the circumstances of the individual case—according as the action is sthenic or asthenic. We must also keep in view that when erysipelas prevails as an epidemic its type often varies considerably from that of the epidemic which immediately preceded it. Thus, in some epidemics, we find that antiphlogistic treatment can be carried out actively and with success; while in others the slightest amount of depletion proves hurtful, and the disease rapidly assumes a typhoid character.

The general indications of treatment are to diminish inflammatory action when violent and well marked, and to allay irritation and febrile excitement. In young robust patients, where the constitution has not been impaired by dissolute habits, and where the febrile symptoms are violent, and assume the sthenic or inflammatory type, general blood-letting may be had recourse to; but it is seldom that such treatment is indicated in this disease, and in the severer forms, where the surface is very much inflamed, the local depletion from incisions will be found in a great measure to supersede it.

In the majority of cases the constitutional treatment should consist in clearing out the stomach and bowels by the administration of emetics and purgatives. The best purgatives to use are mercurials followed by salines. The circulation should be lowered and diaphoresis favoured by minute nauseating doses of antimony. Some recommend that antimonials should be combined with salines, but such a combination is objectionable—first on account of the disagreeable taste, which causes the patient to take it reluctantly and irregularly; and, second, because the diaphoretic action of the mixture may be checked and interfered with by the exposure to cold, which its purgative action necessitates. If antimony does not answer, or if there be gastric irritation or diarrhœa, I would recommend you to substitute ipecacuan in combination with morphia. Indeed, wherever there is great constitutional irritation, opium—unless contra-indicated by its effects in regard to head symptoms—is a most useful remedy, either alone, or combined with antimony or ipecacuan; but it should never be given until the bowels have been well opened, nor when there are violent head symptoms with tendency to coma. In the latter stages of phlegmonous erysipelas, where diffuse abscesses have been opened and sloughs are being separated, opium is of great value to allay irritation, support strength, and procure sleep.

Though in phlegmonous erysipelas the treatment is at first antiphlogistic, both locally and constitutionally, yet as the disease goes on, especially when the sloughs are separating, we must support the patient's strength by stimulants and nutrient diet.

In œdematous erysipelas, on the other hand, the treatment should not be antiphlogistic; the limb should be bandaged from the foot or hand upwards, so as to give it support; friction with the hand to favour the returning circulation, diuretics and alteratives to act on the kidneys, skin, and bowels, and assist the elimination of the fluids from the body, followed by the use of iron in moderate doses, are all beneficial. From the amount of œdema and tension it is necessary sometimes to make punctures in the part, but they are apt to take on a sloughing action; a slow form of ulceration takes place, which often proves fatal. It is a condition indicating low vital power, and is rather a symptom than a disease, and therefore punctures should not be made except in extreme cases, where the tension is great. Stimulants do good in some forms of œdematous erysipelas, especially when it occurs in patients of dissipated habits. They are often indicated at an early period of the disease, by a soft, tremulous, and quick pulse, and delirium of a low muttering character. Stimulants should be given cautiously, however,

and their effects narrowly watched, and care must be taken at the same time that the bowels be properly regulated.

In all severe cases, during the latter stages, or so soon as the skin becomes moist and the febrile symptoms subside, or when typhoid symptoms appear, we should exhibit tonics, stimulants, and nutrient diet. Quinine, with mineral acids, wine, ale, or porter, are the best. The diet should consist of animal food; but must be regulated according to circumstances. The patient must be cautioned against any violent exertion during convalescence, as fatal syncope sometimes occurs under these circumstances, as it does after severe fever.

During the progress of the erysipelas preparations of iron are very beneficial, and during convalescence they should still be given, but then only at intervals, and not continuously. By some, iron is considered a specific in all forms of the disease, but my experience warrants me in saying that the impression is erroneous, though in many forms of erysipelas it is a most valuable remedy. It should be given in moderate doses, say from 15 to 20 minims of the tincture of the perchloride four or five times a day. I have found iron to be especially useful in cases of the erythematic form; but when the disease assumes an acute character, and is accompanied with a quick full pulse, or in erysipelas of the head when there is a tendency to violent delirium, iron should not be given.

Great care and judgment are required in the use of local measures, such as cold and warmth. The application of cold has a tendency to lower greatly the vitality of the part, and is therefore objectionable in many cases; but a stronger reason why it should be avoided is, that it may do positive harm, for as the local affection is, in general, only symptomatic, any agency which would suddenly repel the action might induce metastasis to a more important part. Warm or tepid lotions are pleasanter to the patient, and are attended with greater benefit. They soothe and relieve, while at the same time they are unattended by danger if carefully attended to.

If a part be affected with acute erysipelas, arising after an operation, and the erysipelatous action spread and become diffuse, then the stitches should be taken out and the wound left open, so as to relieve the tension and favour the escape of the discharges.

Where the erysipelas is idiopathic, the application of anodyne fomentations, such as some very weak acetate of lead and opium lotion, or even dusting with finely powdered starch (hair powder), will often be sufficient. When the local inflammation is tense and painful, and where there is a risk of its spreading, we must use more active measures. In some cases punctures in the part are indicated, and these, with warm fomentations afterwards, answer very well. In other cases incisions give more relief. The late Sir William Lawrence proposed to make one or two long incisions when the limb was very tense, instead of several smaller ones; he said it produced less irritation; but it causes great deformity; and, moreover, the surface of such a wound is apt to take on an unhealthy action; so that it is better to make several incisions about two inches in length than to make one incision six inches long. The incisions relieve tension, not only by depletion but by

allowing the exudation and sloughs—if there be any—to escape. In erysipelas of the face incisions should not be made, even though the tension be great, and even punctures are objectionable on account of the deformity they would produce. When the disease attacks the scalp, however, it is often necessary to make incisions, to prevent the important deep structures from being affected.

In erysipelas of the face, the best local treatment consists in the application of some fine bland powder, which will allay the local irritability; the part should then be covered with a layer of cotton wadding, to protect it from the air. This, with proper constitutional treatment—the use of diaphoretics and purgatives—will generally cure the disease. But such cases must be watched very carefully, because there may be effusion of purulent matter in the eyelids, and then we must make incisions to relieve the patient. Sometimes the face may be painted over with oil, which soothes and cools the part; but occasionally it seems to give rise to irritation. A change from the powder to the oil often does good, but, as a rule, the powder gives more relief, and is besides more cleanly. When hot fomentations are used, care should be taken, on their removal, to cover the part with a layer of cotton wadding to protect it, otherwise the irritation will be increased.

In phlegmonous erysipelas free incisions are to be made in the part affected, because here not only is the skin affected, but after a time the fascia and intermuscular septa, as well as the subcutaneous and deep cellular tissue. Effusion, either serous or aplastic, takes place under the fascia, and between it and the skin, and hence the bogginess, tension, and apparent softening of the limb. The treatment requires to be very active, and the incisions must divide freely the fascial texture. In the arm we often make incisions along the radial and ulnar sides as well as in the front. When infiltrated suppuration occurs, a mere opening and counter-opening, as in ordinary abscesses, will not do, but several incisions must be made to give free vent to the acrid purulent matter. Much sloughing of the aponeurotic textures will often take place, especially when they are very dense, as for example the fascia lata of the thigh, or the fascia of the forearm, however active the treatment may have been, and hence the necessity for free incisions to allow the sloughs to escape or be removed, as they would otherwise keep up great irritation.

A remedy very frequently used in erysipelas is the local application of nitrate of silver; but, so far as my experience goes, it is not generally attended with good results. If we apply it over a large surface, the remedy becomes worse than the disease. Sometimes it is applied round the limb, beyond the affected part, so as to arrest the progress of the disease, and occasionally it does so; but in the majority of cases the disease will spread beyond the line of the nitrate of silver. Blisters have been applied to the limb for the same purpose, and by them too we sometimes succeed in arresting the spread of the disease. The principle is correct in both cases—namely, to get rid of the diffuse inflammation which is characteristic of erysipelas, and substitute a more healthy form of inflammation with plastic exudation which may limit the local action. But we cannot be sure of exciting this more healthy action either by

blistering or by nitrate of silver; and the parts to which they are applied are not unlikely to assume an erysipelatous or even sloughy character.

During desquamation close attention must be paid to the state of the kidneys, as albumenuria is apt to occur, and this is always a bad symptom.

Before leaving this subject, I would repeat the caution that during convalescence from an attack of erysipelas great care should be taken. The circulation is always impaired during the progress of the disease, and continues so in many cases throughout a long period of convalescence. This state is sometimes attended with a risk of fatal syncope. The patient should therefore be kept at rest, and very quiet, for some time after the violence of the disease has passed away.

LECTURE XIII.

Furunculus or Boil: its Characters, Progress, Pathology, and Treatment—Carbuncular Boil—Anthrax or Carbuncle: its Appearance and the Conditions which give rise to it: its Local and Constitutional Treatment.

THE term FURUNCULUS or BOIL is applied to a diseased condition affecting the true skin, and sometimes the cellular tissue underneath. It assumes the character of a firm circumscribed inflammatory swelling, of a deep red colour and conical form. It is attended with acute throbbing pain, and a sensation of itching, burning heat, together with great irritation of the surrounding parts, and constitutional disturbance. At the base the swelling presents a considerable degree of hardness, and there the colour presents a lake tinge. This colour gradually shades off towards the apex, where some whitish or yellowish-looking matter may be seen shining through the wasted integument. The matter is only an imperfect kind of pus, and its evacuation gives little or no relief; often, indeed, the reverse, on account of the irritation set up by the interference. It consists of portions of broken-down cellular tissue mixed up with sloughy unhealthy pus.

Boils vary in size from that of a large pea to that of a walnut. They may appear singly or in groups; but if singly they are apt to follow each other in very rapid succession. They may be situated in any part of the body, but they are said chiefly to affect the fore part of the body, more particularly the face, neck, and armpits. Doubtless they do often occur on these parts; but it is by no means unusual to find them in localities the very opposite of these, as on the back, nates, and thighs.

The progress of formation may be either rapid or slow, according to the state of the constitution and the violence of the disease. The first form it assumes is that of a small pimple-like projection, and the pain is of a hot, itching, and irritable character. The patient probably irritates it further by scratching or squeezing, and instead of going away, the swelling increases, the base becomes broader and harder, and the body prominent and conical. Thereafter it gradually becomes more congested, until at length it presents the character already described. At length the skin begins slowly to ulcerate, and that generally by a series of small openings. From these unhealthy pus is discharged, and ultimately the minute apertures in the skin merge into one. A small mass of dead cellular tissue—the core as it is called—is then discharged, and thereafter the pain ceases. Healthy action succeeds, and the part contracts and heals rapidly.

The disease is essentially a circumscribed unhealthy form of inflammation of the skin and subcutaneous cellular tissue, terminating in imperfect suppuration. This suppuration is induced by a mortification of the affected cellular substance, which proves a source of irritation. When this is discharged by ulceration of the apex, the disturbing cause is removed, the diseased action ceases, and the part heals.

The states of the constitution which give rise to or accompany it are generally those associated with derangement of the digestive functions. This is the case in almost all diseases of the skin—overfeeding or starvation may give rise to it. Rich and stimulating diet, pastry or sweetmeats, over-indulgence in the use of wine, spirits, or malt liquors, or, in short, anything which tends to disorder the system. Exposure to cold and wet, sleeping on a damp bed, or extraordinary fatigue, may also induce the disease. It frequently occurs, also, during the convalescence of patients from febrile attacks, and is often associated with rheumatism.

The *Local Treatment* of FURUNCULUS is very simple, so much so, that in ordinary cases surgeons are seldom consulted. The boil should be first poulticed, and after a time opened by means of a crucial incision. A narrow bistoury should be run fairly through the base in both directions, and then the core or slough squeezed out. Should the core prove slow of separation, however, apply nitrate of silver. Thereafter apply poultices, and when the slough has separated use simple warm-water dressings or stimulating lotions as the case may require. Such is the treatment most commonly adopted, but in many cases it is best not to open the boil. A good method is to apply a galbanum plaster over it, and then allow it to take its course.

The *Constitutional Treatment* must be conducted on general principles, according to the circumstances of each particular case. If the patient be feverish, with hot skin, scanty urine, and constipation, small doses of colchicum, and saline purgatives, are useful, followed by small doses of rhubarb and potash to regulate the bowels. If the urine be very acid, alkalies should be exhibited, but if it be at all phosphatic, alkalies are to be avoided, and dilute nitric or nitro-muriatic acid given instead. In cases accompanied with anæmia, the use of chalybeate remedies will be found very beneficial; and in cases of debility, the use of quinine and other bitter tonics may be had recourse to with advantage. But this department of the treatment really belongs more to the domain of the physician than the surgeon.

Sometimes we meet with cases in which, after the small boils fade away, one particular boil becomes very much enlarged and prominent, assuming a less acuminated form, and having a broader and more congested base, with greater surrounding hardness. This is termed the CARBUNCULAR BOIL. In this form the skin texture is more largely affected, and the subcutaneous cellular tissue becomes secondarily involved.

The *Local Treatment* of carbuncular boil is of greater importance than that of the simple form. We require to make very free crucial incisions through and beyond the base—not only in order to allow the matter at the top to escape, but also to provide for the separation of

the slough, which would cause great irritation if left behind. This treatment will also tend to relieve tension and diminish pain. Poultices are then applied to allay irritation and favour the separation of the slough. The constitutional treatment must, as in the case of ordinary boil, be regulated according to the condition of the patient's health.

ANTHRAX or CARBUNCLE is another inflammatory disease of the skin tissue, having some similarity to boil, but much more serious in its character, always attended by great constitutional disturbance, and not unfrequently terminating fatally. It is a most painful and exhausting disease, generally associated with a weak, irritable, and vitiated state of the system, and it has its origin chiefly in predisposing constitutional causes.

The disease may be described as being a peculiar kind of inflammation of the skin texture, to which it is at first wholly limited. Small points of unhealthy pus are deposited in the integument, and this process is attended with intense pain, of a hot burning character, owing to the denseness of the texture and the consequent resistance which the fluid meets with in the process of deposition. The substance so thrown out can hardly be called pus; its consists rather of a sloughy material, formed from the *debris* of broken-down texture which has been destroyed by the violence of the inflammation.

The swelling is at first of a hard and brawny consistence, and a dusky red colour, but it soon becomes boggy in character, and the red darkens into a livid purple hue. In form it is more flattened and diffuse, and not acuminated as in the common boil. It is usually extensive, but varies in its dimensions from the size of half a small orange to that of an ordinary saucer, or even larger. For example, it may sometimes extend from the neck down to the shoulders and upper part of the back.

On close examination we find that the skin texture has become thickened and somewhat opened out by the exudation deposited in it, and by the increased vascularity, while its interior is found to be studded over with little white suppurating points. These at length ulcerate, and pour out a flaky semi-purulent fluid; afterwards they tend to enlarge, and at length coalesce and form an opening large enough for the escape of the slough. This separates very slowly, but when once completely thrown off the healing action sets in.

Although the disease lies originally in the skin, it may, in consequence of the violence of the inflammation, spread by contiguity to the deeper-seated textures. Thus it generally involves the cellular tissue beneath the skin, and often extends to the fascia beyond. The fascia, if dense, presents very little vascularity: it therefore speedily undergoes a sloughing, unhealthy action, and so the diseased condition spreads to the muscles underneath, and may thus involve greater depth of parts, in some cases laying bare even the bones if not interfered with.

We seldom meet with more than one carbuncle at a time, and it is generally situated on the back, or on a part endowed with but little vitality. Sometimes, however, it occurs on the forehead or on the scalp; and I have seen a very considerable one form on the epigastric region in a patient who had long suffered from dyspepsia.

The disease occurs most commonly in people of debilitated constitution, who have formerly lived freely. Mr. Hunter states that he never saw carbuncle in an hospital patient but once, and that was in a gentleman's butler. This broad statement, although true in the main, might tend to mislead, for we do find the disease occurring in patients in the lower ranks of life, more especially amongst such of them as are debilitated from previous habits of intemperance or from disease. Its chief victims, however, are those who take much animal food and wine without taking sufficient exercise. In these the digestive organs become deranged and unfitted for their work. The kidneys also become affected, and the urea which they ought to eliminate is retained and circulates in the blood. A very frequent predisposing cause is the gouty habit; and some of the worst cases I have seen have occurred in connection with Bright's disease, on account of the blood-poisoning which arises from the non-elimination of the urea from the system. It is said to be a symptom or accompaniment of malignant fevers, as the plague, and here usually several of these tumours appear simultaneously.

The constitutional symptoms which accompany this local affection are generally those of irritative fever tending to typhoid, and consist of rigors, restlessness, and want of sleep, nausea, vomiting, and diarrhœa, alternating with profuse sweating. The tongue is pale, loaded, and flabby. The pulse is quick, weak, and irritable. The expression of the countenance is pinched and anxious. There is palpitation, and in bad cases giddiness, drowsiness, and tendency to coma, and sometimes low muttering delirium.

With regard to the pathology, carbuncle may be classed with those diseases which are characterised by excessive local action, with deficiency of vital power. The local affection is similar to that of furunculus, only differing in degree and extent of diseased action, rather than in essential nature. The diseased skin has a brawn-like appearance when seen in section. The process of suppuration is tedious and partial, the death of the cellular tissue is very extensive, and ulceration of the surface takes place slowly, and, as we have already stated, the diseased action involves the fascia and more deeply seated parts, and in some cases lays bare the muscles and vertebræ.

The *Local Treatment* should consist in making free crucial incisions into and beyond the diseased part. By so doing we will not altogether prevent sloughing, because, from the very commencement of the disease, sloughs are almost sure to be present; but we prevent the disease from spreading in surface and in depth, and also permit the free escape of the slough which keeps up the irritation. The incisions must be carefully made; they must go completely through the inflamed textures, and beyond them into the healthy skin, or otherwise the disease will extend from the circumference. Though smaller incisions may relieve the pain and tension for a time, they will not cure the disease. No matter how weak the patient be, the incisions ought to be free.

Sometimes when the carbuncle is large a third perpendicular incision may be made with advantage. After the incisions are made, charcoal or yeast poultices or soft cotton wool soaked in hot water and charcoal are to be applied, and if the slough be slow of separating, the

application of nitric or sulphuric acid or potassa fusa is useful, so as to destroy it thoroughly and rapidly. These escharotics should only be applied on the dead textures, and not on the skin. The incisions are apt to bleed very smartly, but we need not be afraid of this, unless in certain localities, such as the scalp, and there the vessels must be tied. An ordinary carbuncle on the back or hips seldom goes deep enough to involve any large vessel. The bleeding in these cases comes from the highly inflamed and highly vascular integument.

In certain states of the constitution, however, as in cases where it is complicated with or supervenes on albuminuria, we must beware of continued slow hæmorrhage. For in such cases the blood is apt to be deficient in fibrin, and wants the natural tendency to coagulate: hence the part may not bleed much when cut into, but afterwards the blood begins to ooze away gradually, and would soon exhaust the patient if not arrested. When this happens, the actual or potential cautery should be applied so as to check the oozing. This, however, will seldom be required if the patient be carefully watched.

Different opinions are held as to the constitutional treatment of carbuncle. Some hold that it is a disease of debility, whether induced by over-feeding or want of nourishment, and that, therefore, we should support the patient's strength by giving quinine, animal food, and stimulants, from the first. Others, again, consider it to be a very violent form of inflammation, and hold that the treatment ought to be antiphlogistic, consisting of low diet, and the use of antimonials to allay the fever. Now, either of these plans, if carried out to the extreme, would be dangerous. The disease is one of irritability of constitution, mixed up with considerable debility, and it ought not, therefore, to be treated either with large quantities of stimulants or with remedies of a too depressing character.

The constitutional treatment should be conducted on the same principles as those inculcated in the treatment of the senile gangrene of Pott; for in both of these diseases there are irritable states of the constitution, and a tendency to weakness from previous disease, with violent local action. Therefore the regimen should be of a nutritious but non-stimulating kind. The use of opiates is very beneficial, except in cases where the patient is labouring under Bright's disease. There opiates are contraindicated, as, under such circumstances, their use is apt to be followed by a particular form of coma. Sometimes, in such cases, chlorodyne may be sparingly given. But under any circumstances, we must always watch carefully the effects of any opiate we may give. Along with the opium, small doses of antimony may be given at first, and in the latter stages tincture of muriate of iron should be substituted. The bowels should be kept regular, and the urine examined from time to time. The diet should be nutrient, but non-stimulating, such as farinaceous food, milk, and white of eggs; but if the patient has been used to very free living, this diet would be insufficient to sustain him long, and the exhaustion so produced would prevent the wound from healing. In such cases, therefore, when the local action is somewhat abated, a more stimulating diet is necessary, and some animal food may be given with advantage.

When the patient is very weak, and also during convalescence, stimulants may be allowed, and light wines, such as claret or hock, are the best—not burgundy, for it produces as much febrile action as port does. Port is not to be given unless the patient has been in the habit of taking much of it previously. Champagne, with a little brandy, is useful when the patient is very low, or where diffusible stimuli are needed ; also brandy or other spirits, either alone or mixed, with tincture of cardamom or other aromatic tincture. Alkalies are to be avoided as a rule, but they may be administered under special circumstances. Where there is heartburn or acidity of the stomach, with flatulence, give oxide of bismuth with aromatic powder. In some cases of flatulence, dilute nitric acid, in small doses, answers better than any other remedy. In all cases where there is great constitutional irritation, we must give opiates to procure rest, but their effects should be very carefully watched.

LECTURE XIV.

Tumour-growth : its Definition—Distinction between Tumours and Hypertrophies and Inflammatory Swellings—Structural Classification of Tumours—Clinical Classification of Tumours—Simple Tumours : their Characters and Vital Manifestations—Malignant Tumours : their Characters, etc.

FROM the study of inflammation, and those diseases which are more closely associated with it, we now pass on to the consideration of morbid nutrition, as it is exhibited in TUMOUR-GROWTH. In its ordinary acceptation, the word tumour means a preternatural swelling of any kind. In surgical pathology it has a special signification, and is understood to denote "an overgrowth resulting from morbid or abnormal nutrition, which, instead of merely supplying new material sufficient to repair waste of tissue, yields a redundancy, thereby leading to overgrowth, with more or less alteration of structure and form." But this definition is not sufficiently exact. A true tumour has other characteristics besides those mentioned. The substance thrown out is not merely ordinary plastic material in excess, as in inflammatory swelling, where there seems to be merely a deposit of new matter into the texture; but, in a true tumour, the material exuded by the capillaries of the part has in itself a peculiar innate power of attraction and selection, whereby it can reproduce a texture peculiar to itself, often different and always distinct from the natural tissue in which it grows; while, in ordinary nutrition, the material is either assimilated to the textures to which it is supplied, or gradually removed by absorption. The increase in tumours is dependent on the surrounding tissues for little more than the vascular supply, which increases with the size of the tumour.

The definition given above is also deficient, inasmuch as it seems to include some hypertrophies. As many of these, however, come practically to be spoken of and treated as tumours—both being the result of a morbid formative force tending to increase—they are often included in the same class. There are, however, some well-marked points of difference; and as these have practical bearings on the mode of treatment, and as the enumeration of them may serve to bring out more clearly the characteristics of true tumours, I shall endeavour to point out—*First*, the distinctions between hypertrophies and true tumours; *Secondly*, the differencebetween inflammatory swellings and tumour-growths.

In simple hypertrophy the organ maintains its natural type, form, and structure, however much it may increase in size—it is, as it were,

Plate V

Fig. 2.

Fig. I.

Waterston & Son Edin. Lith.

merely magnified. Thus, in hypertrophy of the thyroid body, the gland becomes simply enlarged, but this enlargement differs from tumour-growth, inasmuch as the organ is not materially altered in structure, form, or function, but is simply magnified in size. Then again, in enlargement of the prostate we have mere hypertrophy; the lateral and middle lobes become enlarged and project beyond their natural boundaries, but no abnormal formation of texture exists in connection with it. Another example may be found in the pregnant uterus. The walls of that organ undergo during gestation an enormous hypertrophy, yet its type, form, and functions remain unchanged, only modified. Again, in hypertrophy of the heart we find another instance of a similar kind.

Now, in tumour-growth there is an essential deviation from the normal form and type. This deviation tends towards deformity, and goes on increasingly even in the simplest examples, as in those in which the structure of the tumour is at first analogous to that of the organ or part in which it has been developed. Thus, for example, in fibrous tumour of the uterus, there is at first a great similarity to the texture from which it grows, but gradually it assumes a distinct form and character of its own. Again, in the case of nasal polypus, the growth is almost identical with the mucous membrane of the nose, from which it springs; but as the tumour advances in size, there is a marked deviation in form and mode of growth. In a fatty tumour we find simple fat, but it assumes a form which fat in its normal state never presents. In lipoma of the nose there is hypertrophy of the skin at first, but this at length gives rise to deformity by outgrowth.

In addition to these points of contrast, it has been suggested that hypertrophies are usually adaptations of structure to meet some emergency of the system, or in other words provisions of nature to meet a special purpose; and examples are given of hypertrophy of the heart in impeded circulation, of the uterus in pregnancy, and of the bladder in stricture. In each of these cases there exists a necessity for increased muscular force, in order to overcome manifest obstructions, whereas, in cases of tumour-growth, there is the absence of all adaptation or apparent necessity.

It is difficult, however, to prove the argument good in every case. In enlargement of the prostate, for example, we can trace no adaptation or purpose; it seems to meet no emergency in the urinary system, but rather to interfere with its functions. In hypertrophy of the tongue, also, we find a condition which, instead of being a response to any physiological call from the economy, is, in fact, an actual impediment to the healthy action of the organ, and is hazardous even to life itself. Remember, therefore, that in hypertrophy we have simple enlargement of the organ by the additional growth of matter like that already existing, while in tumours the new material is essentially different in form and vital tendencies.

We shall now consider the points of contrast between inflammatory swelling and tumour-growth, which have been well pointed out by Sir James Paget.

First, The accumulation of lymph, which causes the swelling in

inflammation, is, as we have seen, due to the excited action of the capillaries of the parts at or adjacent to the seat of exudation. There is no evidence that the swelling increases by any inherent power or self-organising matter, but rather the contrary; for we have seen that if inflammatory exudation be poured out rapidly, and in large amount, it may interrupt the nutrition and destroy the vitality of the part. On the other hand, tumour-growth is of itself; it has a vital and pathological individuality of character, so that while tumours may be regarded as parts of the body, yet they grow by an inherent force of attraction and assimilation, by multiplication of their own cells, and they depend upon the surrounding textures for little more than the blood from which they derive the materials appropriate for the purpose of organisation. A tumour increases constantly and with increasing rapidity. An inflammatory swelling increases only so long as the morbid condition of the surrounding parts continues.

Second, The material or exudation thrown out in each case has different capacities of development, for while in tumours the new material may alternately assume a variety of forms or structures, the inflammatory exudation possesses scarcely more than the single capacity to form white fibroid tissue.

But perhaps the most marked points of contrast between inflammatory swelling and tumour-growth are to be found in the conditions which are presented by each subsequently to the organisation of the materials or exudations which compose them. Organised inflammatory exudations, like those provided for the repair of injuries, are usually of a kind which constantly approximate to the healthy condition and form, if not to the exact tissue of the parts amongst which they are situated, or they gradually waste away, and all superabundant matter is thus got rid of. With tumours the case is just the reverse. In them the new material continues to increase and develope by inherent and peculiar self-organising power, diverging farther and farther from the natural form and structure. Although resembling natural tissues, yet they differ in their laws of development; they are not dependent on, nor do they grow in proportion to the rest of the body, but often seem to develope themselves at the expense of the system, for they continue to increase, while at the same time the surrounding textures and the body generally may be wasting away.

Tumours, therefore, must be regarded as overgrowths possessed of inherent self-organising powers, irrespective, in a great measure, of the maintenance of the rest of the body, and developed without any apparent function or purpose.

Having thus briefly indicated the conditions which distinguish inflammatory swellings and simple hypertrophies from true tumour-growths, we shall next proceed to consider the CLASSIFICATION OF TUMOURS. A difference of opinion exists in the present day regarding the grounds on which our classification and nomenclature are to be based. Some pathologists propose that our distinctions should be founded on the appearance and structure presented by different growths as examined with the naked eye and by means of the microscope; but, whilst by no means undervaluing such structural appearances, it seems

to me that mere structure, apart from the vital characteristics of such growths, is by no means sufficient to enable us to distinguish their true nature; and as the structure cannot be fairly examined until after the removal of the growth, I think a more practical classification and nomenclature is that which recognises the characters of the growth, and indicates them by terms expressive of quality, nature, and tendency, rather than by such as denote structure alone. I will therefore adhere to the old terms—*Simple and Malignant*—as expressive of the two great classes into which all tumours may be divided. They are sometimes classified as Solid and Cystic, or hollow; but some tumours are at one period of their growth quite solid, and at a later stage of progress they contain cysts in their interior. This should therefore be regarded as merely a subdivision, and not a classification.

In consequence of the different methods of classification, the nomenclature is very perplexing—the same term being frequently employed to denote two totally different tumours. Now, although the classification adopted in these lectures is purely clinical, seeing that it is only by such an arrangement that we can form a correct estimate of the true nature and significance of a tumour, it is well that the student should have some idea of the structural classification, in order that, when reading pathological works, or listening to pathological lectures, he may not become confused by the two styles of nomenclature. We shall therefore, before proceeding to give a detailed description of the clinical characters of tumours, show very briefly how they are classified by pathologists of the present day, and at the same time endeavour to reconcile, as far as possible, the two methods of nomenclature, by pointing out where they agree and where they disagree.

It is essential that the student should have some knowledge of the various stages of development of new growths before he can thoroughly understand the basis upon which the structural classification is built. We find that the tissue most prolific in the production of tumours is the ordinary connective tissue; epithelial textures are also a favourite site; much less frequently do they develope in the more highly organised tissues, such as bloodvessels, muscles, and nerves. Müller has advanced a proposition which has almost become a law amongst pathologists, and it is this, viz. that the tissue of every tumour has its type in a tissue of the organism, either in its embryonic or fully developed state. This simply means that in tumours we find no new anatomical element—no cell peculiar to cancer, and indeed no cell characteristic of any tumour.

In the development of tumours the first stage is one of *irritation*, and this is speedily followed by increased nutritive activity of the tissue from which the tumour is about to spring; the cells increase in size, and rapidly proliferate by fission and the other methods of cell-multiplication until a large number of small round cells are produced. This constitutes the *stage of granulation*, and if we examine these small round cells we find that they consist of minute masses of protoplasm, destitute of a cell wall, but showing a large nucleus on the addition of acetic acid. Although the majority of these cells composing the granulation tissue are formed in the way described, yet it is very probable

that a certain proportion are derived from migratory white blood-corpuscles. At this stage the development of the tumour may be arrested, and then a tumour is formed which presents all the characters of embryonic connective tissue; on the other hand, *differentiation* may take place, and the tumour assumes the structural characteristics of its class. If its structure be similar to that of the tissue in which it is situated, it is termed *homologous;* if dissimilar it is said to be *heterologous;* and these terms have also a certain clinical value, because, whilst the former is always innocent, the latter is frequently malignant.

Almost every pathologist has a structural classification of his own, agreeing, it is true, with those of others in main points, but differing more or less in particulars; it becomes necessary, therefore, that we should select from these one which is at once simple and exhaustive. The following is the arrangement (slightly modified) proposed by Cornil and Ranvier in their work entitled *Histologie Pathologique.* It is based upon the analogies which the structure of tumours presents to the structure of normal tissues.

Class I.—This includes all tumours which resemble in their histological structure embryonic connective tissue. They are called Sarcomata. This term has a much wider significance in clinical phraseology, as it is very generally employed to designate every tumour, whether simple or malignant, which possesses a fleshy consistence (σαρκος). When employed by the pathologist, however, it simply refers to tumours composed of embryonic connective tissue, and of these there are several varieties founded upon the shapes of the cells and the amount and character of the matrix in which the cells are placed. The first variety is called the *Round-celled Sarcoma,* and this corresponds to the medullary sarcoma mentioned in page 108. The cells are round, and the matrix is small in amount, and presents no fibrillation. The second variety is the *Spindle-celled or Fibroplastic Sarcoma,* or in other words the recurrent-fibroid tumour. It consists of a tissue still embryonic in its characters, but more fully developed than that of the round-celled sarcoma. The cells are placed close together, and are very numerous. They vary greatly in size, are fusiform in shape, and are grouped more or less in bundles, which traverse the tumour in all directions. The matrix is small in quantity, and is slightly fibrillated. The third and last variety is termed the *Myeloid Sarcoma.* This tumour almost always arises in the medullary canals of bones, and is frequently found affecting the parietal bone, or the heads of long bones. A good example is seen in the malignant form of epulis of the upper or lower jaw. It is characterised under the microscope by the presence of enormous cells containing numerous nuclei, and showing all the appearance of excessive nutritive activity. Mixed with these are numerous fusiform cells, and the whole are held together by a very small amount of intercellular substance. The sarcomata are all malignant, but, unlike the carcinomata, they do not so early implicate lymphatic glands. Not only have they a great tendency to recur upon removal, but also to be reproduced in internal organs. They are very prone to regressive changes, and thus some pathologists have described Osteoid-Sarcoma, Melanotic Sarcoma, and Cystic Sarcoma, as distinct varieties.

Class II.—This includes all tumours whose histological structure has its type in one or other of the various forms of connective tissue. Under this heading, therefore, we find the *Myxoma* which has its analogue in the Whartonian Jelly, or tissue of the umbilical cord, and constitutes one variety of nasal polypus; the *Fibroma* or ordinary fibrous tumour; the *Lipoma* or fatty tumour; the *Carcinoma* or cancer; and lastly the *Gumma* or syphilitic gummatous tumour. Carcinoma requires to be studied more fully than the other varieties of this group. It is divided into hard cancer or scirrhus, soft or encephaloid cancer, and glue-like or colloid cancer. In structure it consists essentially of "*a fibrous stroma bounding alveoli, which form by their communications a cavernous system; these alveoli are filled with cells in a fluid more or less abundant.*" This fluid, with the cells floating in it, constitutes the milky juice which can so readily be scraped off from the cut surface of a cancerous tumour. The cells present a great diversity of shape, as they are moulded into an infinity of forms by the pressure which they exert the one against the other in the alveoli. Thus they may be polygonal with acute or blunt angles, fusiform like those of the spindle-celled sarcoma, flat, caudate, or spherical. In size they are also variable, and they enclose one or several nuclei, which in their turn contain one or several nucleoli. The stroma forming the alveoli consists of fibrous bands united the one to the other, and containing connective-tissue corpuscles. A certain class of pathologists maintain that cancer is purely epithelial in its type, and that the increase and formation of the fibrous stroma is due to the irritation of the connective tissue from its infiltration with epithelial cells. The force of this theory is considerably diminished by the fact that cancer may occur primarily where no epithelial structure can be said to exist, as in the medullary canals of bones and in lymphatic glands. Virchow and others, however, consider that epithelial cells may be produced by connective-tissue corpuscles or even by migrated white blood-corpuscles; but if we examine and compare the cells of cancer with those of epithelium, the former are rendered sufficiently distinct from the latter by the fact that they possess no cell-wall and are not glued together. The argument, that it arises, in the case of the mamma, by the proliferation of the epithelium lining the ducts, is valueless, because this proliferation is secondary to the development of the cancer, and is due to the irritation caused by it.

Class III. are the *Chondromata*, or cartilaginous tumours.

Class IV. are the *Osteomata*, or all tumours composed of osseous tissue.

Class V., or *Myomata*, are new growths composed of muscular tissue. Of these we have two varieties: the first excessively rare and composed of striated muscular tissue, and the second much more common and consisting of unstriped muscular fibre. The fibroid tumour of the uterus is an example of the last.

Class VI. or *Neuromata*.—Here again we have a term which may lead to confusion. It is used by pathologists to denote a very rare form of tumour composed of *true* nervous tissue. When employed by the surgeon, however, it refers to tumours situated upon a nerve, and

consisting in an increase or inflammatory thickening of the neuroglya at that point.

Class VII., or tumours composed of vascular tissue and divided into *Simple* and *Cavernous Angiomata.* In the simple the tumour is composed of new vessels bound together by a certain amount of connective tissue, and they may consist of arteries, capillaries, or veins. In the cavernous the structure resembles that of erectile tissue.

Class VIII.—This includes all tumours which have as their structural type epithelial tissue. There are four varieties—viz. *Epithelioma*, *Papilloma*, *Adenoma*, and *Cysts.* In epithelioma the cells are generally flat and deformed, and resemble those of the epidermis. They contain one or more nuclei, and are arranged in many cases peculiarly in relation to each other. Of these arrangements perhaps the most characteristic is that known as the "cell-nest." In this case numerous flat polygonal cells are applied concentrically around a globular cell, like the scales of an onion. There can be no doubt as to the epithelial character of the cells of an epithelioma; but some pathologists, although allowing this, are inclined to argue that they are not of purely epithelial origin. They maintain that it is quite possible for connective-tissue corpuscles to develope epithelial cells. Papillomata are formed by a connective-tissue basis covered by epithelium, which differs in its characters according as the tumour springs from a mucous or a cutaneous surface. Examples of this variety are seen in common warts, condylomatous warts, and some mucous polypi. In structure the adenomata have a close resemblance to tubular or racemose glands. They consist, essentially, in a local hypertrophy of the gland tissue. They are very common in the mammary gland, and in the nose they constitute one of the most frequent varieties of mucous polypus.

Returning to the clinical and practical classification, I proceed to point out the distinguishing characters of simple and malignant growths.

The vital manifestations of Simple Tumours are, slowness of growth, the absence of any affection of the general health constituting cachexia (plate v. fig. 1); little local pain or uneasiness, except such as is produced by their bulk or pressure, interfering with the functions of important organs. They have no inherent tendency to ulcerate, although this may sometimes arise from causes of irritation foreign to themselves—such as the application of pressure, caustics, or discutients. They are usually well defined by a delicate cyst of condensed cellular texture; they have no tendency to involve neighbouring tissues in the same morbid action; and if once thoroughly removed they never return again. In structure they are regular, and resemble in many cases some of the natural textures of the body. Thus we have fatty tumours, or tumours composed of fibrous tissue, or tumours closely resembling in structure the different glands.

Simple growths are readily separable, and freely movable, so that after a careful examination they may easily be diagnosed. These characters will often enable us to distinguish simple from malignant tumours during an operation for their removal. It is most important to find out, say in a mammary tumour, whether it is completely movable, or

whether at one point it is fixed or less defined. If there be complete definition, and if the other characteristics of a simple tumour be present, then the growth alone should be removed. But if the tumour be attached at one point, even though very movable at all others, then, if the patient be above middle life, the surgeon should rather remove the whole breast than run the risk of recurrence by excision of the tumour only. Again, in considering the propriety of removing certain growths near important organs, if the tumour be simple we may proceed to remove it with almost a certainty of success, because such a tumour has natural definitions which prevent it from including vessels or other important parts. For, as a rule, a simple growth, whilst it may adhere to, compress, or displace structures, has no tendency to destroy texture or invade organs contained in a common fibro-cellular sheath. In malignant growths it is different, because in them the tumour often involves parts which it would be fatal to divide. Another essential difference between simple and malignant tumours is, that the former have no tendency to return after removal, either in the same part or elsewhere.

The simple tumour has no tendency to ulcerate unless irritated. Ulceration may take place in a fibrous tumour, which grows very rapidly towards the later stages on account of its increased vascular supply, and from pressure of the mass leading to ulceration of the skin. The part which does ulcerate possesses very little vitality in itself—it bleeds by opening into the vessels supplying the tumour, and there is all the appearance of fungus hæmatodes. From the loss of blood the patient becomes exhausted, and looks yellow and anæmic, with quick pulse. The symptoms here might be mistaken for those of a malignant tumour, but the previous history of the growth will decide its true character. Cases do occur, however, in which simple tumours may, either from irritation or improper interference, degenerate locally, become adherent to neighbouring parts, and even assume some of the vital characteristics of malignant growths, but this degeneration I believe to be merely local. When such a tumour is removed by operation the constitutional symptoms disappear, and there remains no tendency to recurrence of the growth, either in its former site or in any other part of the body.

Malignant Growths are very different in character, both as regards structure and vital manifestion. Generally speaking, they grow rapidly, and are accompanied by marked constitutional symptoms of a cachectic character (plate v. fig. 2). They are painful, apt to degenerate, and have a peculiar tendency to softening and ulceration even in the earlier stages. In structure they are irregular, and in form undefined. On manipulation they feel soft and elastic, with here and there hard resistent portions; although in some parts of such a tumour the elasticity may amount to a feeling of fluctuation, or actual fluctuation be present, yet in no case is it equal throughout. In this they present a contrast to the simple fatty tumour and the chronic abscess, the former of which presents a feeling of elasticity, and the latter of fluctuation, but in each the feeling is uniform in every part. Their tendencies are very aggressive, involving the neighbouring textures directly, or, through the medium of the

lymphatics, affecting the neighbouring glands. Thus the whole system becomes involved in the mischief, and an operation, if performed, is followed at best only by temporary benefit, and, sooner or later, there is recurrence of the disease either in the same locality or some other part.

But in addition to these—malignant growths have some special characteristics which more particularly demand our attention.

1*st*, The structure of malignant growths, whether viewed by the naked eye or by the aid of the microscope, presents appearances very different from those which are to be found in simple tumours. They are of a very unequal consistence, varying from a gelatinous or cerebriform pulpiness to fibroid or fibro-cartilaginous hardness; and all these different conditions may be found in the same growth. Their intimate structure is composed of cells resembling those of glands or epithelium, but larger, and studded with numerous nuclei, showing great power of rapid development. Their structure is not uniform, but consists of dissimilar cells heaped together irregularly. In certain forms of malignant growth, however, the arrangement is more regular, and in these the size of the cells, together with their numerous nuclei, form the distinctive structural character.

Malignant growths may at first assume a definite outline and form, or they may appear as infiltrations into the proper structure of organs, as in acute cancer of the mamma; but this seems to be modified by the structure of the organ affected. Thus, scirrhus or hard cancer of bone at first appears defined in form, so also do the cancerous deposits in the liver. Medullary sarcoma, when it affects the uterus, generally appears as an infiltration. In the breast at first it frequently assumes the appearance of a defined tumour; in reality, however, there is no true definition, the surrounding structures yield to the influence, and not only become affected by, but propagate the diseased action. Whilst malignant growths may be anatomically limited or defined by the structure of the organ in which they occur, yet they are not so limited physiologically. Thus, a malignant tumour, commencing in the interior of the shaft of a bone, is bounded laterally by the dense osseous wall of the bone and periosteum, and at either end by the cartilage of incrustation, but it can never be absolutely limited in the living body, as the blood supplying it circulates; and hence even in such cases the muscles near the tumour very generally show altered structure by the presence of proliferous cells.

2*d*, The tendency to ulceration from softening and rapid destruction of superimposed parts which have been involved in the disease. This is to be distinguished from the ulceration occasionally occurring in large simple growths, where the textures have ulcerated from mere mechanical pressure, or in consequence of local irritation. In malignant ulcerations, the fungating open surface is a part of the disease, and the margins of the sore—supposing, as sometimes happens, that the original growth were to slough out—would not heal, but would continue to propagate the diseased action. "The margins of a cancerous ulcer are themselves cancerous." In simple ulceration, on the other hand, the exudation merely impairs vitality or impedes contraction; and when a

simple tumour which has ulcerated is removed or sloughs out, the margins regain their healthy condition, contract, and take on a kindly healing action.

3*d*, The tendency of malignant growths is to propagate similar formations, either by involving other textures directly, or through the media of the lymphatics, by which the neighbouring glands and their related structures are implicated in the diseased action. And finally, they are characterised by their great tendency to return after removal, either in the part from which they were removed, or in some other region of the body.

LECTURE XV.

Special Simple Tumours : Simple Sarcoma—Adipose or Fatty Tumour—Fibrous and Adenoid Tumours—Myxomatous Tumours.

In yesterday's lecture, after briefly defining the word tumour, and explaining the difference between tumour-growth and hypertrophy, I endeavoured to point out to you the distinctive characters of simple and malignant tumours. These I wish you to bear in mind as we proceed farther to discuss individually the varieties embraced in each subdivision. The first subdivision includes the special simple tumours, and of these we shall first consider Simple Sarcoma. This term indicates a tumour of a somewhat fleshy consistence resembling that of the natural tissues, the development of which appears to depend upon the persistent increase of its vascular supply. It is the simplest of all forms of tumour-growth, and very closely resembles hypertrophy, only it is an outgrowth different in character and form from the part in which it grows, though resembling it in texture. The ordinary polypus is an example; in structure it very closely resembles the mucous membrane from which it grows, but in form and character it entirely differs from that membrane, inasmuch as it has a narrow pedicle, and projects widely. These polypi seem to be recurrent, but it is not a recurrence of the tumour, because several grow together, and though the larger ones be removed some small ones are left behind, which in turn develope and require removal. The ordinary nasal polypus is one of the simplest forms of tumour.

Another form of simple sarcoma consists merely in increased development of the skin, and is found chiefly affecting the nose; it also arises from an increased vascular supply of the part. So long as the part retains its normal form and type it is considered to be hypertrophy of the skin; but when a tumour diverging from the natural form of the part is produced, giving rise to great projection as in this case, then it is called a vascular sarcoma. The tongue sometimes, from an increased vascular supply, becomes very much enlarged, but this is only hypertrophy, as the swelling keeps to the normal type and form of the organ, and is not discordant from the natural textures. There are other kinds of simple sarcomatous tumours, but their characters are much the same as those mentioned. They all grow from an increased vascular supply, and at first their growth is very slow.

It is this form of growth, and especially the hypertrophies included

in it, that we can do most to get rid of by medical treatment and local applications without the necessity of operation, especially in the earlier stages of the growth. The application of blisters or iodine to the tumour, and the use of the iodide of potassium internally, often cause simple tumours of the thyroid body to disappear very rapidly, though certain forms, such as the vascular pulsating tumour of the thyroid gland, do not disappear so readily ; these, however, possess some of the characters of an erectile tumour. In hypertrophy of the tongue also we may often avoid the necessity for operation by the use of deobstruent remedies, as iodine, or by applying pressure to the tongue, along with deobstruents internally—avoiding all preparations of mercury. Occasionally, however, operation, by incisions or excision of a V-shaped portion of the organ, must be resorted to. It does not follow that, because such medical and local remedies may prevent the necessity of operating, it is the safest or best method of treatment. For example, in polypus of the nose no one would continue a long course of deobstruent remedies when a single twist of the forceps removes the disease effectually with little pain and no danger. So also, in lipoma of the nose, the disease might be got rid of, perhaps, by strict diet and regimen, or local deobstruent applications, but it can be much sooner removed, and with less harm to the constitution, by operation. Generally, when removal by operation can be readily and safely performed, it is better to have recourse to it than to use a long and debilitating course of medicines.

The Adipose or Fatty Tumour is another very simple form of tumour, and in structure it is hardly distinguishable from a mass of fat, though it may sometimes be a little firmer. It consists simply of adipose tissue, in the neighbourhood of which it is generally developed ; but it grows apart from it, and is isolated at first by a layer of condensed cellular tissue. Felt from the surface it may appear perfectly equal, and in loose tissue it is often pendulous. All fatty tumours are more or less lobulated, even although they may seem to be smooth and rounded. Sometimes they are quite flat, and these often give a feeling of fluctuation or elasticity, and may therefore be mistaken for a chronic abscess. A fatty tumour can hardly be mistaken for a malignant growth, because there is no cachexia present nor quick pulse, and besides it is of very much slower growth. The latter character will also help to distinguish between it and an abscess. This kind of tumour generally lies quite loose, but occasionally it may insinuate some of its lobules below and between muscles, and so be closely related to large vessels, or the tumour may adhere to the under surface of the skin, and the layer of condensed cellular tissue be obliterated. In such cases the removal of the tumour becomes much more difficult. We must therefore take care not to use improper means of getting rid of such a tumour, as they may cause adhesions, and so render a simple operation tedious, or even dangerous. The fatty tumour sometimes undergoes degeneration of a purely local kind, and in such cases it may be mistaken for a malignant growth. Sometimes an abscess forms in a fatty tumour, giving rise to malignant symptoms, with great pain and a bloody discharge ; but if the original history be that of a simple

fatty tumour, we may proceed to operate without hesitation, for its deep connections will be loose and easily separated.

The simplest and safest method of treating the fatty tumour is excision, and that as early as possible, before complications arise, and before its bulk renders its removal formidable.

The FIBROUS TUMOUR is composed of fibrous tissue arranged in regular masses, and sometimes lobulated. Between the different layers of fibre there are generally interstices containing fluid. When a section of the tumour is made, the appearance presented is very like that of the fibrous textures of the body. It is separated from the surrounding structures by a layer of condensed cellular tissue, and has often a sort of capsule or covering of its own.

ADENOID TUMOURS, *Pancreatic Sarcoma* of Abernethy, are usually included under fibrous tumours. They have nearly all the characteristics of fibrous tumours, but are different in structure. They were originally called pancreatic, from their great similarity in appearance to the pancreas. Their general characters are the same as those of the fibrous tumour—slowness of growth, greater consistency than the vascular sarcoma or fatty tumour, and greater tendency to undergo local degeneration or breaking-down, or to become ossified or calcified; the latter change, however, takes place much more frequently in the true fibrous than in the pancreatic tumour. Under the term pancreatic sarcoma were included at one time many tumours which were not very like the pancreas, though possessing a gland-like structure, and therefore the term adenoid or gland-like tumour is now used, as being more correct, to include them all. The Adenoid Tumour is frequently developed in the neighbourhood of glands, such as the parotid, compressing that structure, or displacing it, so as to resemble a tumour of the parotid itself.

Fibrous and adenoid tumours are perfectly simple; they have no tendency to become malignant; they may, however, degenerate locally so as to ulcerate and fungate, and give rise to symptoms of malignancy, but they do not become truly malignant so as to affect the constitution and forbid their removal by operation. They are very firm in consistence, and are well defined. When they come in contact with important parts, such as large vessels or nerves, they may lie upon, partially surround or push them aside, or even become adherent to them, but they never really involve other structures, and thus they can be safely removed by careful dissection, which we could not calculate on doing were the tumour malignant.

The tendency to ossification or calcification is most marked in true fibrous tumours, especially those of the uterus. This ossification is due to a deposition of earthy matter, carbonate or phosphate of lime, into the tumour, which gradually becomes smaller—the organic matter diminishing in proportion to the increase of earthy matter. It is a slow process, and generally occurs in tumours in the structure organs. This deposition of earthy matter in fibrous tumours may, however, occasionally take place rapidly, and accompanied by symptoms which embarrass our diagnosis. In the case from which I removed this tumour of the forearm, the history was very much that of a

malignant growth. It had attained its present size in less than three months, was very hard, irregular in form, adherent to the skin, which was beginning to ulcerate, and adherent also to the deeper structures, and the patient suffered from severe darting pains along the forearm. Yet you see it is merely a calcified tumour, which by its pressure irritated the neighbouring parts, and so gave rise to these symptoms.

Although the general history of the adenoid is very much the same as that of the fibrous tumour, its growth is sometimes more rapid, especially in the later stages, owing to its increased vascularity.

A tumour like the fibrous or adenoid, of dense structure, may lead to ulceration from its pressure on the superimposed parts, and so give rise to symptoms of malignancy.

The diagnosis between a small, deep-seated, fibrous tumour, and a scirrhous tumour of the breast, is sometimes difficult. The chief points to be noticed are the regular and defined form, the greater mobility of the fibrous tumour, and the absence of any retraction of the nipple, together with the age of the patient and the history of the case. When the patient is above thirty-eight—before which time scirrhus seldom appears—if the diagnosis be doubtful, and we find the tumour undefined and adherent, it is better to remove the whole breast than risk recurrence from leaving any portion of the tumour, as the loss of the gland is not so important at that age. If a fibrous tumour be very large, with darting pains through it, and ulcerating or fungating, with sanious discharge, the symptoms may be very similar to those of a malignant growth. These conditions, however, in a tumour originally simple, do not contra-indicate an operation. We must here trust to the history of the case and the state of the constitution, whether there is any real constitutional cachexia, or only exhaustion from irritation and discharge.

As regards the *Treatment* of all fibrous and adenoid tumours, even in the earlier stages, the best plan is excision, and the sooner it is performed the better, as there is less likelihood of other parts being interfered with by the tumour; and there is also less chance of any subsequent complication in the progress of the case. As I have already said, a fibrous or adenoid tumour may be removed with perfect safety, even when lying near important parts, because, though it may displace these parts, and so require careful dissection, yet the other textures are never involved in the diseased action. In this case of fibrous tumour, which I now show you, the great sciatic nerve was completely embedded in the growth, but not affected in any way, so that it was readily dissected from the deep groove you see in it. Again, in this enormous tumour, which lay under the sterno-mastoid, and occupied also the deep parotid and facial regions in close contact with the great vessels, nerves, and important structures of the neck, I was able, by careful dissection, to remove the growth entire; it did not implicate these structures.* In this other cervical tumour, also from beneath the mastoid muscle, owing to the original development of the tumour, it had separated the internal jugular vein from the vagus nerve and the carotid artery—the vein being partially obliterated by long compression;

* See *Dublin Quarterly Journal of Medical Science* for November 1863.

but the carotid and vagus, though lying closely related to it, were not involved, so that this tumour also was safely removed.*

THE MYXOMATOUS TUMOUR.—In structure this closely resembles mucoid tissue such as is seen in the umbilical cord and vitreous body; and under the microscope it presents oval, elongated, or branching corpuscles embedded in a slightly fibrillated matrix. Its growth is very rapid, and, in this respect, it is one of the exceptions to the rule that simple tumours grow slowly. From its consistence and feeling to the touch, it is apt to be mistaken for a fatty tumour. It is softer, however, and almost boggy to the touch, whilst it does not possess the uniform elasticity so characteristic of the fatty tumour. It may attain a very large size in shorter time than other simple growths, as you will see from this specimen, which I now show you, which was removed from the dorsal region of an adult and weighed rather more than eight pounds. It had attained that bulk in eighteen months. Myxomatous polypi of the nose are very common.

The treatment is the same as in the case of other simple tumours, viz. removal by the knife or by polypus-forceps in the case of the nose.

* See *Edinburgh Medical Journal*, October 1867.

LECTURE XVI.

Cystic Fibroma—Encysted Tumours or Wens—Erectile Tumours and Nævi.

ANOTHER form of tumour which may be considered as a modification of the fibrous tumour is the CYSTIC FIBROMA or FIBROCYSTIC tumour. In fibrous and adenoid tumours we have seen that in the fibrous structure of the tumour there are interstices containing fluid. In many cases these form regular cysts, and sometimes the cystic portion of the tumour developes itself at the expense of the solid part, which then becomes compressed, and forms as it were septa between the cysts. In this way the multilocular or cystic sarcoma, of which this tumour of the testicle is a very perfect specimen, seems to be produced. In the interior of these cells or cysts we find a thin glairy fluid. They used to be called hydatid tumours, but are not so in reality. In the ordinary fibrous tumour we may have a large cyst occupying the centre. This happens from absorption of the septa and a number of small cysts uniting to form one large one. If this goes on, a condensed layer, formed by the fibrous stroma of the tumour, will be produced outside, forming a sort of sac. In this fibro-cartilaginous tumour the same cystic conditions may be seen. In some of the hypertrophies cystic formations may take place, as in the thyroid body, where there is at first simple enlargement; then part of it forms into a cyst, producing a fluid swelling of part, and giving rise to what is called hydrocele of the thyroid or cystic bronchocele. The fibro-cystic tumour, then, may be regarded as merely a modification of the fibrous tumour, becoming cystic at different points, and sometimes even resulting in a single cyst.

The *Treatment* is the same—namely, complete removal of the tumour. In certain positions where we cannot do this, or when there is a moderately-sized tumour containing fluid, as in hydrocele in the neck, it is possible to destroy the tumour by drawing off the fluid, and then injecting iodine into it; but this method of treatment is much less certain. It may be followed by partial ulceration and fungation, and if the tumour were near important parts this might prove very dangerous. In some cystic tumours of the breast, however, and in cystic tumours of the thyroid body, in which we cannot remove the tumour, we may lay it open or tap it, and then inject iodine. We sometimes make counter-openings so as to favour the escape of the fluid, and prevent deep-seated inflammation. In such exceptional cases this is the best plan of treatment; but as a general rule the cystic tumour should be removed as soon as possible. In any form of tumour we may occasionally get rid of the growth by other means than excision, such as injecting the solu-

tion of chloride of zinc, or some other caustic solution, into the interior of the tumour, so as to cause it to slough out; but this is attended with considerably more pain and risk, and is by no means so certain as removal by the knife, which is, therefore, the best treatment in all simple fibrous or fibro-cystic tumours.

Another form of simple tumour is the ENCYSTED TUMOUR or WEN. The tumour consists of a sac filled with fluid, and it occurs in or immediately beneath the skin. Wens vary in size from that of a small seed to that of an orange, and though met with in other parts, are chiefly found on the scalp and face.

The character of the encysted tumour or wen is different from that of the cystic sarcoma, in which the fibrous or adenoid tumour becomes converted into a tumour more or less cystic. In the wen the follicular apparatus is apparently deranged, and an altered secretion takes place. These tumours have received different names according to their contents, which are sometimes semifluid like honey, and are then called "meliceritous;" or greasy, when they are called "steatomatous;" or they are of a curdy consistence, and are then called "atheromatous." But the contents are the least important part of the tumour; they have nothing to do with the tumour-growth. The cyst-wall in this case is in reality the tumour, and the contents merely a secretion from it, so that if we remove the cyst and leave parts of the contents in the wound, they could not create a similar tumour, being simply a secretion without any vital power. The origin of the tumour seems to be some disease in the follicular apparatus of the skin leading to obstruction of its ducts, and an altered action resulting from that. There are generally several cysts present in the same patient, and not merely a single one; when there is only a single wen we ought to be very careful, because these single growths are often a form of medullary sarcoma, and very different from the true simple wens or encysted tumours.

The complete removal or destruction of the cyst is the principle of *Treatment* of wens. This tumour is originally loosely connected, and so, in general, is easily dissected or pulled out; but in some cases, such as an encysted tumour of the lip or eyelid, where the cyst-wall is very delicate and tears easily, we cannot generally dissect or tear it out entire. Therefore, as we cannot be sure of removing the whole cyst, we cut out an oval portion of the tumour, evacuate its contents, and then destroy the remainder of the wall with a finely-pointed piece of caustic. Briefly, the treatment of the wen consists in complete removal of the cyst, either by excision or by destroying it with caustic, after evacuating its contents.

ANGIOMATA OR VASCULAR TUMOURS.—These are tumours composed of vessels, and they are divided into two distinct groups, according to their intimate structure. The first group, called *Simple Angioma*, includes the various forms of nævi. These are composed of vessels, whether veins, arterioles, or capillaries, although their true character may be somewhat obscured by the changes they have undergone. Thus we may find them uniformly dilated or sacculated, and very tortuous. These vessels are held together by a certain amount of connective tissue, which is sometimes more or less loaded

with fat, as in cases where the nævus is situated in the subcutaneous fascia. In form they may be flat, projecting, or even polypoid, and their colour varies from a bright red to a deep violet or bluish tinge. The second group is called *Cavernous Angioma*, and the type of this is the erectile tumour. In structure it is very different from the ordinary nævus, for we have here a cavernous system, the alveoli of which are bounded by dense fibrous tissue and freely communicate the one with the other. The alveolar walls, moreover, are lined by delicate epithelium, and the cavities are filled with blood. The circulation through this system of alveoli is very active, and the tumour performs the function of the capillaries of the part inasmuch as it lies intermediate between the arteries and veins. You will observe, therefore, that the structure of an erectile tumour bears a close resemblance to the structure of the corpus spongiosum penis, and like it, it bleeds most profusely when cut into. The section of such a tumour, after it has been injected, has been well compared to a portion of sponge which has imbibed a large quantity of red wax, and which has been cut open after cooling. Some authors have endeavoured to draw an additional distinction between an erectile tumour and the nævus met with in children; the former they say occurs in after-life from a tumour-growth actually taking place, whilst the latter is congenital. It is very difficult, however—in fact impossible—to make good this distinction. The erectile tumour varies much in size, sometimes very small, at other times a very large growth in muscles or in the cavities of bones.

In the great majority of cases of erectile tumour, and especially in the earlier stages, there is no tendency to enlargement of the great vessels in the neighbourhood, nor do the vessels entering the tumour present any very great enlargement outside the tumour, though they become dilated and tortuous immediately after they enter it. There is a form of aneurism by anastomosis, CIRSOID ANEURISM, where we find a large number of dilated and tortuous vessels; it is most commonly seen behind the ear and on the scalp, but this is different from the erectile tumour.

Formerly erectile growths were considered to be malignant; Mr. John Bell stated that the tumour, if interfered with at all, should be cut *out* and not cut *into*, and that there would be little or no bleeding, and no tendency to return if we cut wide of the growth. He was the first who drew attention to the fact that the neighbouring vessels were not at all enlarged, but he was wrong in supposing the disease to be malignant.

As regards the *Treatment* of erectile tumours and nævi, the general principle is to cause obliteration of the vascular texture by inducing inflammation and coagulation; and this may be effected in various ways. Cure, more or less complete, may arise from the part becoming inflamed from accidental causes, as in this remarkable case of arterial nævus of one side of the face, in which gumboil resulting from a carious tooth led to inflammation and abscess of the cheek, and to obliteration of the greater portion of the nævus. There was not the slightest tendency to hæmorrhage when I opened the abscess, and the

part which had been affected by inflammation gradually assumed the natural colour and appearance. I wished to excite inflammation in the rest of the nævus, but the patient declined, so the nose and upper part of the face remain vascular and discoloured. We may strangulate erectile tumours by passing needles with strong threads through the base of the growth and tying them very tightly; the part which projects sloughs off, and the part still left is affected by the inflammatory action set up, and this action is sufficient to obliterate it. This plan is the best when the nævus is very prominent. In other cases, the nævus may be destroyed by introducing a fine sharp-pointed syringe, and with it tearing up the vascular structure, and then injecting a little of the perchloride of iron, which will cause coagulation, followed by inflammation and obliteration of the vascular texture. The principle of treatment is to cause inflammation with effusion of lymph into the vascular texture, and consequent obliteration of the vessels. It is right to mention here that cases are recorded in which fatal results have followed on treatment by injection. I have not seen any such cases, but can imagine the possibility of the point of the syringe penetrating a vein, and the injection forcing a coagulum into the circulation, and so leading to fatal results. The rule for avoiding such a result is that which I have just indicated—namely, to break up the vascular structure with the point of the syringe first, and then to inject the perchloride solution.

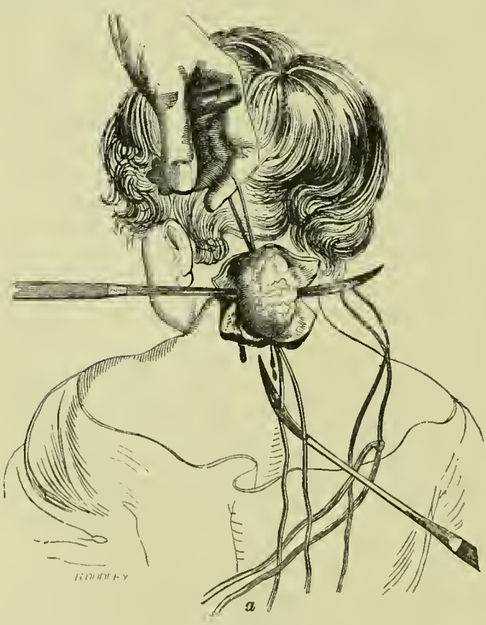

Fig. 13.

Another remedy is galvano-puncture, or electrolysis, by which means we hope to cause coagulation of the blood and excited action. The needles used are carefully insulated (except for the distance of about a quarter of an inch at the point) so as to avoid the cauterising effect they would otherwise have upon the skin. When the needles are introduced they must be moved about in the tumour, so as to break up its texture and allow the action to pervade the whole growth. The operation should be repeated every four, five, or six days, until the tumour

Fig. 13. Erectile tumour in a common situation. The integument, uninvolved, has been reflected by flaps. Transfixion is being completed, previous to deligation. *a*, A larger ligature, in the act of being pulled through. It fills the aperture of puncture, preventing bleeding; and besides, bears a stronger strain in the tying.

disappears. Each application is marked by the consolidation of a portion of the tumour, which in the course of time becomes absorbed. This is a very valuable method of treatment, and is frequently followed by the most satisfactory results; but still it should not be considered as a general method, as there are a great number of nævi and erectile tumours, which are more advantageously treated by some of the other means. Electrolysis is especially indicated in those cases in which the erectile tumour is deeply seated, and covered by healthy undiscoloured skin. Until eight or ten years ago, our interference in such cases was limited to dissecting off and reflecting the superimposed structures, so as to expose the tumour without touching it with the knife, and then strangulating it by strong ligatures, and when the growth had sloughed and separated replacing the flaps of skin (fig. 13).

In order to place the perchloride of iron treatment in contrast with electrolysis in such cases, I may quote the following cases from my own practice:—An infant six weeks old was sent to my care on account of a deep-seated pulsating erectile tumour occupying the palm of the hand and extending up the wrist. The tumour had been growing rapidly, and at one point the skin was thin and discoloured. I used the injection of perchloride of iron, and part consolidated, but on employing it a second time, the consolidation was followed by inflammation, and the separation of a small central slough. Moreover, bleeding from the ulcerated surface took place, and this returning from time to time necessitated amputation in the forearm when the child was eight weeks old. I show you here the cast of the hand of an infant, affected with a deep-seated pulsating erectile tumour, and very similar to the former case. I employed electrolysis in this case, and the growth began to consolidate and contract. Here is the cast of the hand when the case was completed, and when you compare it with this preparation of the amputated hand, you will understand the true value of electrolysis when applied to proper cases.

It has also been proposed to tie the large vessels passing to the tumour. The common carotid artery has been tied in erectile tumours in the orbit, and the operation has been occasionally successful. Here the tumour, and the vessels supplying it, are limited by osseous boundaries and canals, and the obstruction of its vascular supply to a considerable extent may prove successful. But in erectile tumours of the soft parts, such as this erectile tumour of the long flexor of the great toe, in which I tied both the posterior tibial and peroneal arteries without effect, ligature of the vessels is not so certain. Where the tumour is suitable, the best plan is to strangulate it. The perchloride of iron injected, or threads dipped in it passed through the tumour, are very useful, and so is galvano-puncture. Ligature of the great vessels, though sometimes successful, cannot be depended on.

The venous nævus is larger and more flattened generally, and wants the pulsating feel, but is in all other respects the same as the arterial nævus, and the treatment is the same.

LECTURE XVII.

Malignant Tumours—Brief Outline of the Varieties of Carcinoma, viz. Scirrhus, Colloid Cancer, Epithelial Cancer—Characters, Causes, and Symptoms of Carcinoma: its Diagnosis, Prognosis, and Treatment.

Cancer is a generic term including all forms of malignant growth, whether hard or soft; and is usually characterised by the presence of peculiar proliferous cells, indicating great tendency to rapid growth.

The different forms of Carcinoma are *Scirrhus*, *Colloid* cancer, and *Epithelial* cancer. The most frequent form is scirrhus or true hard cancer. This growth presents a peculiar appearance—a dense white structure, almost like that of a fibrous tumour, but very different in true character. It apparently contracts the textures and consolidates them, gradually bringing the different parts into closer contact. The white fibrous texture is sometimes arranged in masses, and projections pass off from the central mass to the different parts of the organ. This is well seen in scirrhus of the breast. The feeling on cutting through scirrhus is much the same as that experienced in cutting up cartilage partially ossified—the knife passes through it with a crisp grating sound.

Another form of carcinoma has the white striated fibrous bands arranged in a peculiar way; they pass towards the surface, and form as it were septa, with interstices between them. These are filled with a sort of gelatinous matter, like melted glue or jelly, of a pale-yellow or dark-brown colour; the septa themselves being cancerous matter, and the fluid part also containing the proliferous cancer-cells. This is the colloid or glue-like form of cancer.

A third form of carcinoma, the epithelial cancer, is found affecting certain textures, such as the skin and mucous membrane, and presents a sort of villous appearance. On examination, the cells are found to possess a form different from the ordinary cancer-cells, but closely resembling those of epithelium; though larger and containing more nuclei, being more proliferous. From its resemblance to epithelial structure, this form of growth was at first supposed to be innocent, and not really cancerous. It frequently occurs in the lower lip.

In certain cases the hard cancer assumes a somewhat different form; thus it may occur as an infiltration poured out rapidly into the tissue of an organ, distending it and giving it a very swollen appearance. These are all forms of carcinoma possessing different structure and different appearance, but the vital manifestations of the tumour are the same in all cases.

The hard cancer differs from simple tumours essentially in possess-

ing all the characters of malignancy. It is of slow growth compared with some other forms of malignant disease; but is always rapid compared with the simple growths. It has not so much tendency to involve the parts in the immediate neighbourhood as the soft cancer or medullary sarcoma has, but it affects the lymphatics at an earlier period. It gradually, however, breaks through the limits of the organ in which it is developed, and then involves the neighbouring textures in a similar disease, and proceeds very rapidly. The general health of the patient is always affected sooner or later, and generally from the beginning. The patient has an exhausted and anæmic appearance—the cheeks are sunken, and there is a yellowish colour of the skin, with a quick pulse, and this even in the early stage. It used to be a question whether the constitution was affected in the first instance, giving rise to the cancerous deposits; or whether it was affected secondarily as a result of the cancerous growth. Now, however, there can be little doubt that we must look upon true carcinoma as a constitutional disease, though it may be excited by local causes; and in the latter case the prognosis for relief will be more favourable. Still, in such cases the condition would not have occurred unless there had been the predisposing cause in the constitution.

Carcinoma is very often hereditary, though it may not affect every generation. We must not trust too much to the history we get from the patient, because those affected with cancer often try to keep it as secret as possible; and thus other members of the same family may have been affected without the patient knowing it. Where the cancer arises from local causes—and certain forms of epithelial cancer, very often do so, such as the chimney-sweepers' cancer, which is of local origin, but is truly epithelial cancer—there is little tendency to the return of the disease after removal. In the lip, also, there occurs a cancroid form of epithelioma, arising from some local irritation, such as that from a decayed tooth, or from smoking strong tobacco in a short pipe. In such cases there is little tendency to a return of the disease; whilst other forms of epithelioma, not arising from local irritation, though removed wide of the disease, return either in the same part or elsewhere. In true epithelial cancer the disease is not more localised than in the other forms of cancer.

The symptoms of carcinoma are a peculiar hardness, and pain of a sharp darting character shooting through and from the centre of the part. This sometimes occurs in irregular paroxysms, while at other times the pain is hot, burning, and almost constant; the latter more especially in epithelial cancer. In old people the pain is generally not so severe. The peculiar hardness of scirrhus is important in diagnosing between it and other tumours, except, perhaps, fibrous tumours, which are sometimes rather difficult to distinguish from hard cancer. We must therefore look to other symptoms than the mere hardness. The want of complete definition will help you to diagnose between fibrous and carcinomatous tumours. If there be any want of definition, we should remove the whole organ in which it is situated, as for example the breast, rather than the tumour alone.

Hard cancer attacks the mamma very frequently, also the testicle —though not so often as the soft cancer—and very frequently the uterus; also glandular structures generally, and parts of the mucous membrane—the mouth and lips, the rectum, anus, and the pyloric orifice of the stomach. The lungs and liver are not unfrequently affected by it. In the liver it assumes a peculiar tubercular appearance. The hard cancer is somewhat slower in growth than other malignant tumours; it may go on for three or four years without being noticed. It seldom commences before middle life—very rarely before 35, generally later; from 38 to 40 is a very common age, though I have known cases occur much earlier, but these are exceptions: it thus differs from soft cancer in this respect.

When the carcinoma ulcerates, the ulceration proceeds very rapidly; the edges of the cancerous ulcer involve the neighbouring parts and destroy them. A fungus is thrown out, bleeding takes place, and the patient sinks from the irritation and exhaustion caused by the ulceration.

The best *Treatment* of the hard cancer is early removal by excision. When it attacks the breast, the sooner we remove the entire organ the better, before the lymphatics have become affected. This may not ensure absolute immunity from return of the cancer, as it is a constitutional disease, but it gives the only chance of that, and will afford the patient relief for many years. Cancer often recurs in from four to eight years, but I know of one well-marked case of scirrhus of the breast which I removed twenty years ago, in which the disease has never returned. Excision is the least painful remedy, and causes least disturbance of the general health, and, if done early, gives the patient the best chance. But if the glands have become affected, and the disease be more widely spread, some maintain that we should not interfere at all; this, however, is too exclusive. If the glands be much affected, and if the skin be tubercular, then on no account should we operate, as there would be no definition; but if the lymphatics be not much affected, and the skin not tubercular or brawny, then the only chance is to operate, though the case is not so favourable as one in which the glands have not become affected. It is said we should not operate, but desist from all treatment; in this case, however, the patient, obtaining no relief, is led to try any remedy, and this often hastens the fatal termination. Excision, even as a palliative, is, I believe, the best treatment, and we should remove the affected glands as well as the tumour. There are, however, certain cases in which we ought not to operate, as in cases where the lymphatics are very much affected, or where there is an undefined tail-like projection creeping up from the breast towards the axilla. In cases of cancer where the skin is affected—red and brawn-like or tubercular—we can have no true definition even of the local disease; I consider that in such cases operation is unwarrantable. In any cases of cancer when the pulse is persistently high, above 100, the prognosis is unfavourable, as a low form of erysipelas is almost sure to supervene after the operation. A new treatment has lately been proposed in cases of cancer—namely, the subcutaneous injection of weak acetic acid into

the tumour. The principle of this is so far correct, and was suggested long ago by Professor Bennett, who showed that the cells of cancerous matter disappeared under the use of certain re-agents—among these being acetic acid—and were formed into a sort of amorphous matter. In cases of hard cancer not admitting of excision the injection of the acetic acid is well worthy of a trial, though as yet it has not often been employed, nor with much advantage.

LECTURE XVIII.

Medullary Sarcoma: its Characters, Structure, Growth, and Degeneration; the Constitutional Evidence of its Presence—Melanosis—Treatment of Medullary Sarcoma—Recurrent or Fibro-Plastic Tumours.

In my last lecture I concluded what I had to say with regard to carcinoma, and I now proceed to consider the Medullary Sarcoma, Cerebriform Tumour, or Soft Cancer. These different terms indicate very well the general characters and appearances of the disease. When seen recently, the tumour is exactly like a portion of brain substance, and is therefore called cerebriform. This tumour is generally of a soft consistence, and consists of masses of brain-like matter occupying the interstices of a fibrous texture which composes the solid part of the tumour, and which is arranged in septa throughout. This fibrous tissue, as well as the soft matter, is truly malignant, and part of the tumour. After maceration, or when the tumour fungates, the brain-like matter disappears. Like carcinoma, the soft cancer contains the peculiar proliferous cancer cells, though to a greater extent than in the hard cancer. The tumour varies as regards the degree of vascularity, but it is always highly vascular. On injecting one of these tumours, we find throughout the growth some portions of amorphous-looking matter not permeated by vessels; but the greater part of the structure is seen to be very vascular. In some cases we find that a single large vessel enters the substance of the tumour, and forms a dilatation or sort of pulsating vascular pouch not unlike an aneurism. Occasionally, when the tumour is very vascular, the brain-like matter gives way after a time, and the fluid blood passes in from the ruptured vessels, and a sort of pulsating feeling along with fluctuation is produced. The femoral artery has been tied in a case of cerebriform tumour, under the belief that it was an aneurism.

This disease occurs at all ages, and may attack every part of the body, but most frequently the osseous textures, mammary glands, the testicles, and the glands throughout the body generally. In its vital manifestations or natural history the cerebriform tumour differs from the hard cancer in growing much more rapidly—taking sometimes only two or three months to attain a large size, while the scirrhus proceeds with comparative slowness for a malignant growth. This characteristic should always be kept in view. There is not so much pain perhaps in the soft cancer as in scirrhus, but the pain is more continuous. Another character is the vascularity of the part, as shown by the venous enlarge-

ment: this may occur in other tumours from the pressure of the tumour obstructing the circulation, but in the later stages of medullary sarcoma, it is a very constant characteristic. Ulceration proceeds rapidly, so does the fungation, and they soon involve the surrounding textures.

The pulse is generally very quick and somewhat irritable: the patient may not at first look anæmic or cachectic, because this tumour more frequently occurs before middle life than after—generally before thirty—while true scirrhus is rarely seen till after thirty-five. The patient may have a ruddy appearance, but there is generally a tawny colour of the skin. As soon as the tumour attains a large size, it unmistakably begins to affect the constitution—the patient begins to look anæmic and yellow, and there is some febrile excitement at night indicating the hectic condition. From the softness and brain-like consistence and vascular character of the growth, and from its occurring as it often does in organs which are circumscribed by a dense resisting membrane, as in the testicle or breast, we often have the tumour presenting a sort of elastic or fluctuating feeling, exactly like that of chronic abscess, so that the difficulty of diagnosis between them is sometimes great. Again, the contents of the tumour are not only cerebriform, but sometimes fluid or gelatinous, and then there is a distinct feeling of elasticity or fluctuation, and the difficulty of diagnosis is increased. A correct diagnosis in cases of soft cancer is most important, because if one of these tumours be opened by mistake for a chronic abscess, a fungus will protrude, and the disease will spread much more rapidly. In all cases, although the tumour affects both the lymphatics and the surrounding textures, it spreads more rapidly by directly involving contiguous structure than by the mere poisoning of the lymphatics. And even where it does not do so, being anatomically limited—as in the testicle, where it seldom affects the scrotum or the envelopes of the testicle proper for some time—it rather spreads along the cord, because it meets with less resistance. Yet when the tunica albuginea gives way, and the growth comes in contact with the tunica vaginalis, the other textures also very soon become involved.

One point is to be especially noticed—namely, that the muscles in the neighbourhood of a cerebriform tumour, though not adhering to it, contain in their structure a large number of proliferous cells, some of which are identical with the cells of the growth. Even when the tumour has not burst through its resistent envelope or cyst, and where it is apparently circumscribed from the surrounding muscles, as in the arm, we find the muscles in the neighbourhood affected by the disease; and this is important in regard to operations. In other cases, where there is no such limitation, the morbid growth rapidly involves every tissue, especially the muscles, and spreads by contiguity of texture.

When the tumour bursts it fungates, and from that fungus we sometimes find projecting dark-coloured bleeding masses as in medullary sarcoma of the orbit. Here we have a fungoid mass projecting from the eyeball, from which blood is constantly trickling, and which bleeds profusely on the slightest touch. This has been described as a special tumour under the name of fungus hæmatodes.

As regards the history of the tumour, we often find that it is attri-

buted to very slight causes, and that it supervenes on accident or some comparatively trivial disease, and in many instances the tumour closely resembles diseases of a much less serious character. In one case the patient got a blow upon the testicle, which was followed by hydrocele; this was tapped, and the man was quite well. Afterwards he again hurt his testicle slightly; it then swelled very rapidly, and was again tapped, but this time a liquid like hæmatocele fluid came away, and the swelling increased very rapidly. Here the history was very like that of hydrocele converted into hæmatocele from the irritation caused by the injury. The patient then came under my care; the tumour was removed, and on examination was found to be a soft malignant growth of peculiar character which you see in this preparation. In another case a boy received a blow with a stone between the eyes. An abscess followed which was opened. A good deal of bleeding occurred from time to time, which afterwards became more profuse. The appearances were not unlike those of necrosis of some of the bones, but a soft cancerous tumour formed, which assumed the form of fungus hæmatodes, and ultimately proved fatal by repeated loss of blood. These cases show that a soft cancerous tumour may resemble very closely other diseases.

Another form is much firmer, sometimes almost solid and semi-cartilaginous at some points, while cerebriform at others, but it does not differ in true character or vital manifestations from the ordinary medullary sarcoma. But there is a form where the tumour is much more firm and equal, slower in growing, and the structure of which is much more regular, and contains much fibrous tissue, very like the simple recurrent tumour. Its development at first is slow, its structure more equal, and it does not spread so directly by contiguity; but after a certain time it grows quite as rapidly as the cerebriform tumour, and then involves other textures by contiguity of structure. It is only a modification of the medullary sarcoma.

Another form of soft cancer is that termed Melanosis or Black Cancer. It is very distinct in appearance from the other forms of soft cancer, its colour being always dark brown or black, though it is the same as the ordinary cerebriform tumour in its history and vital manifestations. It is of a very soft consistence, and frequently occurs in the skin or subcutaneous tissue, occasionally in the testicle, but most generally in the orbit, either as an independent tumour round the optic nerve, or as a tumour within the eyeball itself. All its other characters are the same as in ordinary medullary sarcoma, with the tendency to fungate and ulcerate and spread by continuity of texture. When the tumour commences in the eyeball itself, the case is not so favourable as when it lies external and does not affect the nerve; then it is at first circumscribed by a cyst of its own, and there is comparatively little risk of its return if removed early.

The melanotic cancer has this peculiarity—that a form of it occurs in the lower animals which cannot be distinguished from the black cancer in man. But in the former case it is not malignant and has no tendency to return after removal, while in the human subject it is plainly and certainly a malignant disease—a melanotic form of cerebriform cancer.

With regard to the *Treatment* of the various forms of soft cancer, we may say that the same rule applies here as in carcinoma, though, if possible, more strongly. Whenever the disease is limited, and in the early stage, then operate at once; for the tumour, if left alone, will very soon involve other textures, and there will be no limitation. When it occurs in a comparatively limited organ, such as the testicle or breast, or in a gland, remove the growth as soon as possible; if we put off doing so the delay is almost sure to lead to fatal consequences. We must, however, always remember that the term limitation is used in a comparative sense, for there can be no such thing as absolute limitation of a really malignant growth so long as the circulation of the fluids through the body continues. Practically there is a great difference between an organ which is anatomically limited, such as the testicle, and a part of the body not limited at all, as the skin or soft textures of a limb. In a limited organ we rarely, if ever, find that the disease returns in the same part, or in the same neighbourhood after early removal, though it may do so in other organs.

We must remember that when this tumour ulcerates and fungates, we can do less even to palliate the disease than in the hard cancer. We may employ opiates internally, and anodyne applications to the part, with the perchloride of iron to check any bleeding from the fungus, and we must support the patient's general health by proper diet. This, however, will only relieve for a short time, and hence the necessity for removing all cerebriform and melanotic tumours early, for here it is even greater than in the case of hard cancer. The injections of acetic acid have not been tried yet in cases of soft cancer, though there is nothing to prevent their use; the acid might, from the softness of the tumour, destroy its cells more easily than those of scirrhus. There is both in the hard and soft cancer a risk of exciting irritation by the use of the acetic acid, and of causing the tumour to fungate more rapidly; but we would be perfectly justified in trying the injections, at least when the tumour had begun to fungate, because then very little can be done to palliate the disease.

FIBRO-PLASTIC OR RECURRENT TUMOURS.—The peculiarity of these tumours is that whilst they are non-malignant, they return after removal. A very large number of cases, however, which are termed recurrent tumours, are really growths of a malignant character, belonging to the medullary group of tumours. These differ in structure in the earlier stages from an ordinary medullary growth, in being firmer and more like a fibrous tumour, but they gradually tend to deteriorate locally and become softer, every recurrence of the growth being marked by a deterioration in its character. The simple recurrent tumour has none of these tendencies, and I believe it to be an exceedingly rare form of growth. The best authenticated case of pure simple recurrent tumour occurred in Edinburgh some years ago, in the practice of the late Dr. Maclagan.*

Many recorded cases of such tumours are really not so, though they may be fibro-plastic in structure. The history of such a malignant recurrent tumour may be mentioned as a contrast to Dr. Maclagan's

* For the history of this case, see Clinical Cases quoted, page 186.

case. A man about thirty-five years of age had a tumour in the epigastric region, which was removed by a surgeon, and returned. Eighteen months or so afterwards it was removed a second time, and again returned. Three years subsequently he applied to Mr. Goodsir to have it operated on, and I then saw it. It was removed thoroughly and completely the third time, but the man had now an anxious look and slightly anæmic appearance. This patient had, moreover, a tumour on the scalp, which, after the removal of the former growth, was observed to increase very rapidly. This also was removed. It was highly vascular, and its section was exactly similar to that of the abdominal tumour—namely, fibro-plastic. The tumour on the scalp had only been growing a few months. The tumour on the abdomen was removed, as I have said, two or three times, and each time it was softer in consistence; the patient's health gradually deteriorated, and he at last died exhausted by the disease. This case, as compared with the former, was truly a malignant disease connected with the constitution, whilst the former was not malignant, but a simple recurrent tumour. The malignant is much more common than the simple fibro-plastic tumour, and is merely a subdivision of the soft medullary tumour, containing a larger amount of fibrous structure than usual, but still truly malignant.

In the true recurrent tumour there are not many free nuclei, nor are there the same proliferous cells present as exist in the malignant recurrent growths. In these, even though the malignant symptoms may not appear at first, yet they become more evident after each removal of the tumour; while, if the tumour be a true recurrent one, the patient's general health remains unaffected. In another case of malignant recurrent tumour in a young woman's limb, Mr. Syme removed the growth once. She subsequently applied to me with the tumour at the site of the old cicatrix. She would not submit to its removal a second time, and then the tumour sloughed out, but the edges—as in malignant growths generally—refused to heal. The malignant fibro-plastic growth has after a time the same proneness to involve other textures as all malignant tumours have, while the simple fibro-plastic or recurrent tumour exhibits no such tendency.

LECTURE XIX.

Simple Osseous Tumours: Exostosis—Enchondroma—Osteosarcoma—Osteocystoma—Osteoma.
Malignant Osseous Tumours: Osteocephaloma—Osteoid Cancer.

As I have already fully discussed the subject of tumour-growth in general, and also the characters of the principal special tumours of the soft parts, it is unnecessary to do more in regard to Tumours of Bone than direct your attention briefly to some of their peculiarities. Tumour-growth in the osseous is the same as in the softer textures, only modified by the greater resistance and hardness of the structure in which it occurs. The peculiar mode of nutrition and development of bone causes tumour-growth in it to be slower, and to have a greater degree of anatomical limitation. Again, as regards the special tumours of bone, each of these has its analogue amongst the tumours of the soft parts, whether in the simple or malignant groups. And in some instances, as that of medullary cancer of bone, the disease is not only analogous to, but very generally identical in structure and character with, the similar disease arising in the soft textures.

Exostosis is an osseous tumour corresponding to the simple sarcoma. In the femur, humerus, and other bones, we meet with a tumour growing slowly, and perhaps not attracting much attention at first, being only troublesome from its interference with the action of the muscles of the limb. It grows from the bone, but, like a true tumour, not in the form of the bone, but as an outgrowth connected to it by a narrow pedicle.

The structure of exostosis is simply that of bone, with Haversian canals and systems in its interior. Its surface is rounded towards the deep aspect of the muscles, and sometimes covered with a texture resembling cartilage of incrustation, so as to favour the action of the muscles as they glide over it. The tumour is generally attached to the bone by a narrow pedicle, but it may have a broad base. Its bulk externally appears to be much larger than it really is, on account of the thick muscles covering it. There is no malignancy in this tumour; it is of slow compact growth, and has no tendency to involve neighbouring textures.

The *Treatment* is much the same as in simple sarcoma, though internal remedies are here useless. An incision is made over the tumour through the skin and superimposed muscles, and the pedicle of the tumour is cut through with the bone-pliers, or with a very fine saw,

close to the shaft of the bone, but we do not require to remove any portion of the bone from which it grows. Inflammatory action takes place on the surface of section and closes it, and there is no tendency to the recurrence of the exostosis.

In many cases nature effects the same process herself to a certain extent, but always with more risk to the patient's life. The pedicle of the tumour sometimes breaks across, and the loose body is left moving about under the muscles. It loses its vitality and leads to suppuration. The abscess so formed bursts or is opened, and the dead portion of bone may be thus got rid of. This accidental occurrence shows us the proper treatment of such a tumour, and even under these circumstances there is no tendency to its recurrence.

In that part of bone where there is cartilage, as in the epiphysis, a tumour is sometimes developed which is analogous to the fibro-cartilaginous tumour of the soft parts. This is called ENCHONDROMA. It often occurs in the heads of the metacarpal bones, but neighbouring metacarpal bones rarely become affected, as the tumour does not involve other textures. The growth looks like a mass of cartilage. After a time there may be some deposition of earthy matter in the cartilaginous matrix, but the cartilaginous condition is the more obvious. It is a simple tumour limited to the texture in which it occurs, and when removed it has no tendency to return. Amputation of a finger is often performed for such a tumour occurring in one of the metacarpal bones. It would be perfectly safe to remove the diseased metacarpal bone alone, but the finger so left would be a very useless one, and hence amputation of the finger is generally preferred.

OSTEOSARCOMA is a tumour of bone analogous to the fibrous growth in the soft parts. The term is sometimes used to imply a malignant growth, but it is really a simple tumour, containing organic or fibrous matter blended with the osseous, and assuming almost a fibrous character. It is perfectly simple, has no tendency to involve other textures, and must be carefully distinguished from certain other tumours of bone, such as cancer of bone or osteocephaloma. Sometimes the osteosarcoma is exceedingly like an ordinary fibrous tumour, a section of the one being hardly distinguishable from that of the other. The tumour is perfectly defined and circumscribed naturally, and can be easily dissected out. It is exactly analogous to the fibrous tumour of the soft parts in all its vital manifestations. Its development is very slow; but if left alone it may attain a large size. In one case of enormous osteosarcoma which ultimately came under my care the application of caustics and iodine had caused the tumour to ulcerate (plate vi.) Amputation was performed under unfavourable circumstances—the patient being very cachectic and exhausted by constant bleeding and discharge from the tumour in consequence of necrosis of the osseous matter of the growth. The great vessels and nerves of the limb passed through the tumour, but were not truly involved in it. There was an enlarged gland in the axilla; but from the history of the case and the feeling of the tumour I knew the growth to be a simple one, and I accordingly amputated the arm. The patient made a good recovery, and there was no tendency to any recurrence of the tumour. One peculiarity in this case was that

Plate VI

the tumour involved both bones of the forearm, while in the metacarpal bones, though the whole hand seems to be involved, yet almost always it is only one finger that is affected ; the other bones are pressed upon, but are not involved in the disease. The tumour in the above case began in the ulna, and as it enlarged it encroached upon the interosseous space, which was destroyed by the pressure. The osseous surface of the tumour at last became blended with the radius, and then, having the same vascular supply, both bones became affected, but not in the same way as occurs in malignant growths. The two bones simply coalesced from the pressure of close contact, and from their vascular supply becoming the same, but this only took place at a very late period of the growth of the tumour.*

The *Treatment* of osteosarcoma is very simple—namely, early removal by excision or amputation, just as in the simple fibrous tumour of the soft parts. It should never be tampered with, but removed as early as possible, as we may thus be able to save a great part of the bone. There is no reason for delaying the operation, as the tumour is sure to increase in size, and its removal is then rendered more serious.

The term OSTEOCYSTOMA denotes a cystic tumour of bone, which is analogous to the fibro-cystic tumour of the soft parts. The various small cysts, which always exist in the interior of the fibrous matter of fibro-cystic tumours, may unite into one large cyst, or one cyst may develope itself at the expense of the others, enlarging and compressing them. In bone the progress is somewhat analogous. A cyst very often forms which contains a sort of fluid matter, the walls of the cyst being composed of the denser portion of the bone. By removing the anterior part of the cyst—and so giving free vent to its contents—and painting its interior afterwards with iodine, we very frequently find that the cavity contracts, the texture becomes condensed, and no recurrence of the tumour or other bad consequences follow. When, however, the bone is very much altered in form, then a part of the bone itself should be removed along with the cyst. We may open up the cyst in its earlier stages, or afterwards remove it together with a portion of bone on either side, or amputate the limbs close to the tumour, without any fear of reproduction of the growth. This cystic tumour of the femur which I show you is perhaps the most remarkable specimen of the disease in any museum. The case occurred in the practice of the late Mr. Liston.

Formerly the term spina ventosa was applied to these tumours, as well as to expansion of the bone by abscess ; this arose from erroneous notions of the pathology derived from looking at dried specimens, such as this.

There is a tumour arising from enlargement of the bone itself, termed OSTEOMA, which is really a form of exostosis. It is chiefly found in the lower jaw ; and when removed by incision has no tendency to return.

The malignant tumours of bone are analogous to, or are identical with, the malignant tumours in the soft parts, with perhaps the exception of the hard cancer. OSTEOCEPHALOMA, or CEREBRIFORM OSSEOUS

* *Edinburgh Monthly Medical Journal*, March 1854.

Cancer, presents all the appearances of ordinary medullary sarcoma, except that there are spicula of bone occasionally in the tumour, from the denser osseous texture giving way more slowly than the soft textures. Very soon the whole bone becomes involved, so that we often cannot tell where bone has existed. There may be no appearance of earthy matter, the whole being converted into a medullary mass.

The form of malignant disease in bone which corresponds to scirrhus or hard cancer is to some extent modified by the texture in which it occurs, its appearance being different from scirrhus in the breast, though very like that disease in the liver. At first, the medulla is chiefly affected; it becomes altered in structure and contains an amorphous-looking deposit, with numerous cancer-cells in it. The Haversian structure yields very rapidly, and the cavity becomes filled with a mass of diseased texture. This condition extends towards the denser part of the shell of the bone, and fracture of the cancerous bone may take place. The disease is generally attended with pain, of rheumatic character, and often supervenes as one of the terminations of cancer in the soft parts, as the breast or testicle. The whole system is contaminated, and deposits take place into the textures of the body generally, and then the bone becomes affected. The cancerous deposit often takes place in circular tuberous masses, just as we find it in cancer of the liver.

These malignant tumours may attack any part of a bone, the condyloid portion or the shaft. In bones where there are hollow spaces, as in the upper jaw, or even in the lower jaw, the soft malignant disease generally developes itself within the bone or between it and the periosteum. In different bones or bony cavities, however, there are some points of difference. If the disease developes itself within the shaft of a bone such as the femur or humerus, then we have a very considerable degree of limitation, perhaps the most distinct anatomical limitation that we can have in the body. The malignant disease is limited so far as it can ever be said to be limited, and hence the local disease can be more thoroughly removed when occurring in the shaft of a bone than when it is in the soft parts. It is shut off, as it were, from the neighbouring textures by the dense osseous walls of the shaft, by the strong fibrous periosteum investing it, and at either extremity by the articular cartilage. Hence this is plainly very different from the same disease occurring in the softer textures, commencing external to the bone and affecting it secondarily, where all the textures become rapidly involved in the diseased action, and no anatomical limitation whatever exists. To profit fully by the limitation, however, it is evidently necessary to amputate at the articulation beyond the tumour, not through the continuity of the diseased bone, so that the cartilage of incrustation may form a complete barrier. At the same time, we must remember that even where the tumour is limited to a bone, there is a great tendency to the appearance of the proliferous cancer-cells in the texture of the neighbouring muscles; and hence in such cases we ought to remove the muscles wide of the diseased part. Certain bones present more limitation to tumour-growth than others—the lower jaw for example. In tumours of that bone situated between the symphysis

and ascending ramus, we should always disarticulate even in cases where part of the bone may seem to be unaffected. From the original development, the texture at the symphysis helps to limit the disease at the mesial line, so that we may safely remove half of the lower jaw, as there is sufficient limitation, and there is no greater tendency to the return of the disease than in the femur or other long bones. Of course malignant tumours of this kind are never to be considered so favourable with regard to prognosis as simple tumours of bone; there is always a greater tendency to a return of the disease, and also a greater risk of pyæmia supervening after operation.

Whilst we may remove the lower jaw for these tumours at an early period in some cases, in regard to the upper jaw, on the contrary, the conditions are entirely different. In it the antrum of Highmore is not truly limited; and, moreover, the so-called tumours of the upper jaw do not always occur within the antrum, and even if they do, the diseased condition extends, and projects into and affects other parts. It may even begin in the turbinated and ethmoid bones, and spread to the superior maxilla; so that in tumours of the upper jaw the disease is by no means necessarily confined to that bone. In such tumours of the upper jaw we may have a sort of polypus projecting into the nostril, with pain felt in the face occasionally, and the eyeball protruded and everted. If the eyeball is merely thrust forwards and upwards, the case is not so unfavourable, as it may depend on the pressure of the tumour on the floor of the orbit; but if the eyeball is turned outwards at the same time, we should avoid all interference, for this condition shows that the tumour has arisen in or has affected secondarily the orbital plate of the ethmoid bone, and probably the base of the cranium; there would therefore be no limitation in such a case. The walls of the antrum of Highmore also are very thin, and soon become involved in the diseased action, and thus there is no definition; so that, though we might remove part of the tumour, we could not remove the whole. We may, however, interfere occasionally to palliate the disease if we do so early. In one case the patient at first was affected with a swelling of the antrum of Highmore, which projected towards the mouth. There was no eversion of the eyeball, and the tumour was supposed to be an abscess in the antrum. An incision was made into it, and a projecting part of the tumour was removed. This caused the tumour to adhere to the whole cheek, which soon became involved. The patient subsequently came under my care, and I removed the upper jaw, as the tumour was defined posteriorly and towards the orbit. All the adherent portion of the cheek was removed, and so I had to dissect a large flap from the neck to fill up the gap; yet the wound healed, and the woman left the hospital apparently well. After some time, however, a similar tumour formed in the opposite antrum, and ultimately the disease destroyed the patient. If in this case—instead of the partial operation—complete removal of the jaw had been performed at first, while the cheek was still unaffected, then possibly the operation might have been successful, or at least several years might have elapsed before any return of the disease occurred.

A tumour of the upper jaw, then, differs from one of the lower or

from one in any long bone in as much as there is not the same limitation in the upper jaw. What limitation there is, is so thin that it is easily broken up by the mere pressure, and by the destructive character of the tumour; and when one of the symptoms present is eversion of the eyeball, we are not warranted in interfering, as this symptom shows that if the disease has not begun in the ethmoid bone, it has at least affected it secondarily. Therefore, while in most cases of malignant disease in bone we may interfere with greater propriety than if the disease were in the soft textures, on account of the anatomical limitation existing in bone; yet there are exceptions to this rule, depending on the structure of the bone and its anatomical relations, as in the case of the upper jaw.

Osteoid Cancer is a very rare form of cancer in bone, which is not often described, and which might at first be mistaken for a simple exostosis. The tumour occurs in young persons, grows slowly, and generally arises in the condyloid portion of a bone. When manipulated, it resembles very closely an ordinary exostosis; but after a time the disease increases very rapidly. There is not the same definition in the osteoid cancer as there is in the exostosis. The tumour rapidly developes itself and gradually involves the condyloid portion of the bone. The cachectic appearance of the patient, the rapid growth of the tumour, and the quick pulse, all indicate the true nature of the disease. The growth itself is very dense and hard, and feels like ivory, which renders its diagnosis more difficult. Softening gradually takes place at some parts; but the great mass of the tumour is very dense. The disease is one rarely met with. In two cases which occurred in my own practice, amputation was performed; in one of these the disease returned in another part of the body and destroyed the patient. This tumour belongs to the carcinomatous form of malignant growth, its cells being exactly like those of carcinoma.

There is another form of malignant disease affecting the condyloid parts of bones, which in its early stage is often difficult to diagnose from joint-disease. It generally occurs about the elbow and knee joints. There is at first some slight swelling, with little pain, and we are apt to treat the disease lightly; but we ought to watch such patients very carefully, for, after a time, symptoms come on which give us an indication of the true nature of the disease. Then it developes itself very rapidly, owing to the loose reticular texture of the condyloid part of the bone; and a section, as you perceive, presents appearances almost exactly similar to those of the medullary tumour of the soft textures.

The *Treatment* is the same as in other malignant tumours of bone—early amputation wide of the disease.

LECTURE XX.

Syphilis: its Modes of Propagation; its Division into Primary, Secondary, and Tertiary—Primary Syphilis—Hard and Soft Chancres, and their Treatment.

To-day, Gentlemen, we commence the consideration of a form of diseased action of a very peculiar nature, inasmuch as, whilst it originates in the local absorption of animal poison, it not only gives rise to constitutional symptoms, but so affects the general system as to induce a true diathesis or constitutional taint, which, instead of terminating in the individual, may be transmitted to his progeny. I refer to

Syphilis.—By the term syphilis we mean a diseased condition induced by the introduction of a peculiar poison—the syphilitic virus—into the system. It arises generally from impure sexual intercourse, and, consequently, most frequently attacks the genital organs; but is capable of affecting other parts by inoculation, as we see occasionally in medical men getting some of the poison into a cut or scratch on the hand. Again, by direct inoculation with the virus, we can produce the sores in other parts of the body besides the genital organs. The diseased condition is generally attended with constitutional effects, resulting from the primary local sore, and hence we speak of the local and constitutional symptoms of the disease under the heads of primary, secondary, and tertiary syphilis. The *primary* symptoms are the local primary sores or Chancres, and a certain degree of febrile action which generally accompanies them, varying in degree in different cases. The *secondary* symptoms are the bubo, the acute syphilitic sore throat, the different forms of skin eruptions, syphilitic iritis, condylomata, and warts. The *tertiary* symptoms include all the more chronic and formidable effects induced in the constitution by the original primary sore, such as disease of bone, chronic affections of the larynx, chronic eruptions, disease of the brain, lungs, liver, kidneys, and other internal organs, accompanied occasionally with specific deposits in the tissues of each, and a peculiar cachectic condition of the patient.

As surgeons, our chief concern is with the primary and secondary forms. Tertiary and congenital syphilis we must consider more briefly. Meantime I direct your attention to

Primary Syphilis.—The primary local affections may be divided, for all practical purposes, into two forms—viz. the simple or soft chancre, and the indurated, Hunterian, or true chancre. The simple chancre is characterised by the shallowness of its surface, which is of a dirty-yellowish colour. It exhibits but little action either in extend-

ing or in its tendency to heal. It is a sore prevented from healing by specific action. There is no hardness of the edges, and though they may be irritable, they are generally without any deposit or thickening below them, and there is frequently more than one ulcer present at a time. Some apply the term abrasion or excoriation to the simple sore to distinguish it from the true or Hunterian chancre; but this is an improper use of terms; for an abrasion may arise from many causes which are non-syphilitic, such as some local irritation, or even from want of cleanliness. The simple chancre presents the above appearances, but it must not be confounded with a simple abrasion of the mucous membrane of the prepuce or glans penis arising from non-syphilitic causes. An abrasion is never followed by any constitutional effects, whilst the simplest form of soft excoriated chancre may be followed by very distinct secondary and even tertiary symptoms.

The indurated or Hunterian chancre generally exists as a single sore. It begins as a pimple or pustule with a hard base; the apex or superficial aspect ulcerates, and extends more or less rapidly by ulceration; after a time it proceeds more slowly, the hard base extending and forming an indurated ring round the sore. Like the soft chancre, the hard chancre is slow of healing. The sore may commence on the side of the integuments of the penis, or on the prepuce, and whilst it extends in surface the hard base continues to extend likewise. The ulcerated surface may heal and yet the induration remain, so that in the prepuce we often find an indurated mass remaining after the ulceration has healed, from which the diseased condition may spread. As the ulceration goes on, the edge may become less marked perhaps, but there is still left a dense ring or margin, very distinct from that of the simple chancre. Even in cases where, from particular local action taking place, phagedæna or sloughing occurs, and where there may be great loss of substance, still the hard margins remain to mark the true character of the sore, and hence this may be considered as one of the most characteristic features of the Hunterian chancre. The constitutional effects following on the indurated chancre are most marked, and it is on this account called the true as contrasted with the soft chancre.

Unity and Duality of the Syphilitic Virus.—Some hold that the different characters of the primary sores and of their effects show that there are two distinct forms of the poison—one much more virulent than the other; but from what I have seen myself of the disease, and judging by the evidence adduced, I do not believe in two distinct poisons, though I consider that the poison may differ in degree rather than kind, and that the same poison may produce different forms of sores, owing to the susceptibility of the person or part affected and other conditions. In proof of this, it has been found that two men have been affected with different forms of sore from the same woman; and several instances of this occurrence are recorded.

As regards the secondary symptoms, we can never tell when they may arise. The character of the soft chancre generally shows that the poison has been less virulent; but, at the same time, secondary symptoms may follow under certain constitutional conditions; even when the soft chancre has healed, and in cases where no hardness

whatever had existed, I have seen secondary symptoms ensue. The simple soft chancre is much less likely to be followed by constitutional symptoms than the indurated; but we ought never to trust to this, nor tell our patients that there is no risk of after-symptoms occurring.

Treatment of the Soft Chancre.—The treatment is to destroy the sore as early as possible with caustic—nitrate of silver and sulphuric acid being the best forms of caustic for the purpose. The escharotic should be applied thoroughly, so as to destroy the sore completely. This application causes a slough to separate, and the sore then generally heals. When we want to be quite sure of destroying the sore, we should employ sulphuric acid, as it chars the surface completely, and the slough separates more quickly than after the use of the nitrate of silver. After the slough has formed and is separating, warm-water dressings should be used—a piece of lint, cut to the size of the sore, is soaked in warm water and applied, the prepuce being brought over the part. This should be changed frequently, and the parts around washed with a weak alkaline lotion, when the dressings are changed, so as to prevent any tendency of the discharges to cause similar soft chancres. The alkaline lotion destroys the potency of the virus to a great extent. Attention to cleanliness is very important, for much of the virulence of disease depends on a want of cleanliness.

After the slough has separated, and when the wound has so far healed, the most useful remedy is the weak black lotion; this is far the best lotion, but we must take care not to use it stronger than four grains of calomel to the ounce of lime water, if of greater strength it might irritate the parts; but here, as with all other sores, we must attend to the appearance of the ulcer under the use of the lotion, as it may lose its effect, though generally it causes the sore to heal rapidly. When the black wash does not answer, the weak sulphate of copper lotion, or the chlorinated soda or sulphate of zinc lotions, are very useful, but they are not often required.

One important point in the local treatment of all syphilitic sores is perfect rest. The patient should be kept recumbent, and the penis suspended towards the abdomen—at least for a few days. If the penis be allowed to hang, it will give rise to increased irritation and vascularity. Rest is absolutely necessary; but it is generally very difficult to get the patient to remain quiet and not go about as usual.

Treatment of the Indurated Chancre.—Here we require to be very active in our treatment. If we see the case early we must destroy the sore thoroughly and completely by another form of caustic, viz. potassa fusa, which is by far the most certain and effective caustic in destroying the indurated chancre. We must apply the caustic, not only to the surface of the sore, but also to its hard ring or base. As the potassa fusa is a very diffusible caustic, care must be taken not to let it spread too much; and for this purpose a little vinegar or lard should be applied, so as to check the too extensive progress of the caustic. The potassa fusa is preferable to nitrate of silver in cases of hard chancre, for the nitrate does not affect the deeper part of the sore, but merely destroys its surface. Nitric acid, likewise, does not reach the deeper part of the sore, and is perhaps less valuable as a caustic than the

nitrate of silver. The potassa fusa destroys the whole sore, and though very painful at first, the pain is lessened as we work down to the base, the vitality of the parts being destroyed. Another advantage of the potassa is, that its alkaline quality tends to destroy the virus more completely than any other caustic. Sulphuric acid is not so applicable to the hard chancre as the potassa fusa, for the sore is generally raised, and a fluid caustic cannot therefore be well applied. Hence, of all caustics the potassa fusa is the most readily applied, the most complete in its action, and produces no undue contraction of the parts afterwards; but if we wish to do any good, we must be very careful to destroy every portion of the hardened base of the sore.

After the chancre has been destroyed by the caustic, a poultice should be applied till the slough is quite separated. There is then an apparently increased surface of sore, but this is due to the retraction of the skin. Afterwards the black lotion should be applied, unless the sore has assumed an irritable condition. This lotion is even more beneficial in the hard than in the soft chancre; the sulphate of copper lotion (3 or 4 grains to the ounce), or the sulphate of zinc (2 grains to the ounce), may also be used occasionally. This sore does not heal so rapidly as the simple chancre. There is a greater specific constitutional cause in action, and the ulcer sometimes remains, not extending, but in a sort of passive condition, showing no tendency to heal, though, as soon as the healthy action is once established, the sore generally heals quickly. In some cases, after we have destroyed the hardened base, though more generally when the base has not been thoroughly destroyed, the hard edge reappears, and the sore seems to be deep. When this occurs, the potassa fusa must be again applied to the edge, and slightly also the surface of the sore; but we cannot now be so sure of destroying the whole surface as at first.

In both the hard and soft chancre we meet with a certain amount of febrile excitement: sometimes it is very slight, but in all cases of venereal sores it is present, and particularly towards night; in some cases it is very marked, and then we require to have recourse to certain remedies, such as acetate of ammonia, and other febrifuge mixtures, along with a little ipecacuan. The bowels should be kept open by saline laxatives, and strict attention paid to the diet, which should be non-stimulating. During the treatment of the primary sore, rest, as already stated, is absolutely necessary.

The indurated sore in many cases refuses to heal; it remains quite stationary, the edges show no tendency to contract, and its surface begins to assume the dirty-grey sloughy appearance it had at first. If this happens after all the ordinary local remedies have been used, then we should lose no time in having recourse to constitutional remedies, viz. preparations of mercury or of iodine, which seem to have a specific action on the diseased condition. Some surgeons in the present day never use the mercurial preparations, but trust entirely to the preparations of iodine, especially the iodide of potassium; but in the treatment of the primary indurated sore, I have no more confidence in the iodide of potassium than I have in so much water. It is very useful in secondary syphilitic affections, but not in the primary stage of the dis-

ease, and it is of no use whatever as a prophylactic to prevent the accession of secondary symptoms. The remedies most to be trusted to are the preparations of mercury, given in small doses, and only when the sore does not heal readily. Mercury is not to be given as a prophylactic, or to cure the primary sore, unless it refuses to heal under the use of the ordinary remedies.

Mercury has fallen very much into disrepute from its having been formerly pushed to an excess. It used to be considered as a specific for all venereal cases, even for gonorrhœa; and in all sores, whether they were healing or not, it was given as a prophylactic in large quantities, the patient being expected to spit so much saliva every day. But this was merely the abuse of a very useful remedy. In many cases, undoubtedly, mercury will produce symptoms very like those of secondary or tertiary syphilis, but, except in certain constitutions, mercury in small doses is the proper remedy to give when the indurated sore refuses to heal. It is sometimes said that secondary symptoms do not follow after an indurated chancre which has healed rapidly; but this mistake arises in great measure from patients being told by the surgeon that there is no risk of secondary symptoms coming on after the primary sore is healed. If, however, as not unfrequently happens, secondary symptoms do appear, then the patient, losing confidence, applies to another surgeon for advice, and hence arises the fallacy as to the non-occurrence of secondary symptoms after an indurated chancre. In the Lock Hospital, however, especially among the female patients, who are necessitated to come back to the hospital for treatment, it is found that secondary symptoms do follow, even though the primary hard chancre has healed rapidly.

The mercurial treatment should not be pushed too far; the simple blue pill or the iodide of mercury in small doses may be given until the slightest fœtor in the breath is produced, or until very slight salivation occur, and then the mercury should be discontinued. We may afterwards use some gentle saline laxative—not purgative—combined with quassia, and after a time a few doses of iodide of potassium (in five-grain doses), though this remedy is not to be trusted to at the first. There is one condition of sore, however, in which we should not use mercury at all, and that is where the sore is very irritable, or where there is any tendency to phagedæna. In such cases the mercury is contra-indicated; it is not a safe remedy where there is much irritability of constitution, or where there is much local irritability of the sore, or much febrile excitement.

The phagedænic venereal sore is met with at certain seasons, and as the result of certain forms of virus, apparently where it is more virulent than usual, or from a want of cleanliness, or in certain states of the atmosphere; under one or more of these conditions the sores have a tendency to take on this action. In such cases the phagedæna proceeds in a variety of forms; we have it assuming the acute irritable form with a black slough, and the whole prepuce sloughing, leaving the glans exposed, or the glans itself being involved rapidly; the phagedænic sore also assumes an irritable, ragged appearance, but without any great degree of inflammation of the penis, and with no black spot, but

proceeding quite as rapidly as in the former case. Sometimes it goes on more slowly, apparently as a simple sore, but undermining and destroying the integument of the penis. Sometimes the phagedæna proceeds very rapidly, as in the grey phagedæna, with a dark-grey slough, and the edges everted, but without the intense erysipelatous inflammation of the black phagedæna; occasionally its progress is excessively rapid, the whole penis in front of the sore becoming gangrenous in less than twenty-four hours. We require to be very active in our treatment of the phagedænic chancre; the surface of the sore must be destroyed with sulphuric or nitric acid to get rid of the unhealthy action, and then charcoal poultices and Condy's lotion, or carbolic acid lotion or oil, applied. If there be any tension it must be relieved, sometimes even by making punctures or incisions along the sides of the penis; if there be phymosis, the prepuce should be slit up. The bowels should be kept open, and a nutrient, but non-stimulant diet given, and febrifuge mixtures to allay the febrile excitement, as in cases of irritable gangrene. In some cases we require to give stimulants to support the strength, but generally in the acute stage a non-stimulating diet should be given. Perfect rest must of course be enjoined. From the rapid spread of the ulceration, a good deal of bleeding may occur, but this natural depletion does good rather than otherwise. In the phagedænic chancre we must avoid the use of mercury, which is not likely to do good, and very apt to do harm; the diseased condition must be treated on the general principles of treatment in ordinary phagedæna, which have been already explained.

LECTURE XXI.

Secondary Syphilis—Bubo—Syphilitic Sore Throat—Syphilitic Eruptions of the Skin.

Secondary Syphilis.—The secondary symptoms of syphilis include the different forms of skin eruptions and diseases, accompanied by some febrile action; certain local conditions, such as bubo, phymosis or paraphymosis—the two latter may also accompany the primary sore—the syphilitic sore throat, the various syphilitic warts, condylomata, and fissures. The skin diseases are generally spoken of first, but as a rule the bubo takes place before the skin eruptions.

The Bubo is one of the local conditions; it is secondary to the primary sore on the penis, but occurs almost simultaneously with it, and sometimes occurs as a special form (*bubon d'emblée*) in the first instance before the appearance of the sore on the penis. Thus, when there has been no sore on the penis, but where a bubo has existed, we sometimes have the secondary symptoms appearing after the usual interval, but this form of bubo is exceedingly rare, and some even deny its existence altogether. I have seen at least two well-marked cases of patients admitted with suppurative bubo, without any sore, in whom chancre appeared on the penis eight or ten days after being in hospital. This form of bubo arises apparently from absorption of the virus from the surface of the mucous lining of the prepuce or glans penis, and the constitution becoming affected in consequence. The ordinary bubo is simply a glandular abscess occurring in consequence of the irritation produced by the sore on the penis, and also in consequence of the poison being conveyed by the lymphatics from the part affected. In a case of ordinary gonorrhœa it is very common to find several glands in both groins affected with enlargement, redness, and pain, and sometimes even suppurating; but these symptoms generally pass off as soon as the painful stage of the gonorrhœa ceases, and there is little tendency to suppuration. A bubo may arise from an ordinary non-syphilitic abrasion of the penis, just as we have buboes in the groin arising from some irritation about the toe-nails; but in the syphilitic bubo the poison is conveyed by the lymphatics into the gland, where it seems to be elaborated, and the pus which forms in it produces exactly the same effects as the syphilitic virus, and by inoculation with such pus we can produce a chancre like the primary sore.

The progress of a bubo is simply that of a gland going on from inflammation to suppuration and sometimes to ulceration. In the

earlier stages we have it marked by hardness of the gland and redness on its surface, and after a time the agglutination of the textures with the cutaneous surface; the inflammation extends, the parts soften, and the abscess points, and ultimately, if left to itself, ulcerates and bursts. In the earlier stages several glands may be enlarged, but in true syphilitic bubo we seldom have more than one gland affected. There the diseased condition seems to concentrate itself, and the inflammatory action goes on to suppuration.

Patients are very often anxious to have the tumour discussed, to prevent this result. With this view the best treatment to adopt is to keep the patient at perfect rest in the recumbent position; apply acetate of lead and opium, or muriate of ammonia lotions, either cold or tepid, to the surface of the bubo, and put the patient on antiphlogistic regimen and diet. Sometimes, at the very first, and before there is any redness on the surface, or before any great amount of inflammation is present, the ectrotic treatment of bubo by pressure is employed. Firm pressure is applied over the gland, so as to give rise to discussion and prevent inflammatory swelling going on; but this is seldom beneficial, and often tends to increase the irritation. The pain caused by the pressure is almost intolerable, and, moreover, it can only be employed at the very first, in the stage when the surgeon rarely sees the bubo. The treatment by rest and warm or cold applications to the gland will sometimes prevent the swelling going on to suppuration, though how far this is beneficial is very doubtful, for in the true syphilitic bubo there is more or less absorption of the venereal poison into the gland, and it is better that it should suppurate, discharge, and so eliminate the poison, than that the deobstruent effects of the remedies used should cause absorption of the virus into the system. It is difficult to prove that there is any danger of the absorption of the virus; but I have noticed that secondary symptoms have often followed more rapidly and more seriously in cases where the bubo has been discussed than where it has not. In spite of all remedies, however, the bubo generally goes on to suppuration, and then the best treatment is to apply warm poultices to the gland, keep the patient at rest, and prevent any unnecessary irritation of the parts. When the abscess is fully matured, then open it from one end to the other; if we open it when there is only a small quantity of fluid in it, the tendency is for the hard matter left to act as a foreign body, and sinuses are apt to form in the neighbourhood. In all cases I prefer to let the bubo maturate as quickly as possible, and when suppuration is fairly established then to open it thoroughly and completely, passing fairly beyond the base of the swelling on each side, so as to lay it well open. This will prevent the risk of sinuses forming subsequently. If there be any portion of the gland still left, and if it be at all troublesome, we should destroy it with potassa fusa or nitrate of silver, and so get rid of the hardened texture. Then apply poultices, and treat it like an ordinary abscess, applying after a time chlorinated soda and other stimulating lotions, and repressing unhealthy granulations. If there be any undermined integument at one point, it is better to lay it open as the bubo is contracting; if we allow one sinus to form, others will form in connection with it.

The above is the treatment for the acute bubo, but the chronic form is much more difficult to deal with. Here the gland is large and painful, but it does not go on actively to suppuration; there is not the same pain and tension that there is in the acute bubo, the inflammation is of a sub-acute or chronic type, and the integuments are rather purplish than red. After some time we may feel a little fluid in the gland, which, however, seems to pass off, and the gland appears to be the same as before, and then becomes indurated.

In this form of bubo a good deal of time is often wasted in the treatment by applying poultices, and giving a more stimulating diet, which really do very little good. Much the most effective plan is to apply a blister over the bubo, which will either discuss it, or cause it to suppurate—more generally the latter. The blister excites a more healthy action, and we get rid of great part of the exudation, whilst the gland texture of the bubo proper is stimulated to more active suppuration, and once it is brought to the suppurative condition, the treatment is the same as that of an acute bubo. When there is much hard gland texture, it is well to destroy it with potassa fusa, which excites a more healthy action. When the skin of the bubo is very thin at certain points, and the great mass of the bubo hard, with little boggy points here and there, and a feeling of some thin fluid at intervals in the swelling, and when the skin is of a bluish colour, a very good plan is to open the bubo with potassa fusa. This was once considered the best method of opening all buboes; but in ordinary acute bubo it is not advisable, as it would overstimulate the parts—there the knife is better; but in chronic bubo, especially in that form of chronic bubo where there is much hardness, and the unhealthy appearance of the undermined integument, the potassa fusa is very useful, as it not only destroys the part acted on to evacuate the contents, but the neighbouring skin, having very little vitality, sloughs, and a healthy action is induced in the harder parts beyond. In all cases it is well to apply some alkaline lotion on the bubo and parts around before and after opening it, so as to prevent any risk of contamination by the venereal virus.

The after-treatment of bubo is not the same in all cases, for buboes take on different actions; sometimes they prove very troublesome, sloughing, and becoming phagedænic. The treatment of the phagedænic bubo is to apply nitric acid or some other caustic to it so as to destroy the phagedænic ulceration, and afterwards use charcoal and other antiseptic remedies just as in ordinary phagedæna. This form of bubo, however, is attended with great danger to the patient, for it extends rapidly both in surface and depth, and we sometimes see the femoral artery exposed and pulsating in the sore; and if the diseased action be allowed to go on, the coats of the artery may give way and fatal hemorrhage ensue.

Another secondary condition of syphilis following after the primary sore is the

Acute Syphilitic Sore Throat.—This can hardly be mistaken for an ordinary sore throat. The tonsils are of a dark-red colour, they rapidly become ulcerated, the edges of the ulcer are ragged, and have an angry red look, and the surface presents a dirty yellow appearance.

Owing to the swelling of its edges it looks like a deep excavation. The ulcer generally occupies one or other of the tonsils, but sometimes it passes towards the uvula and pillars of the fauces. There is often a considerable amount of febrile excitement accompanying the disease, just as in ordinary tonsillitis. The local treatment consists in the application of nitrate of silver to the surface of the ulcer. The use of warm-water gargle, and subsequently chlorate of potash gargle, or the chlorine lotion or alum gargle, may be used. Occasionally when the uvula is œdematous, we require to make punctures or scarify it, as there is a risk of acute œdema glottidis supervening; and with a view to prevent the œdema extending in other directions, we should in some cases remove part of the uvula. The usual antiphlogistic remedies are to be adopted to prevent the further progress of the inflammation.

A more chronic form of the same disease is met with as a tertiary symptom, but it yields readily enough to local applications of nitrate of silver, combined with the internal use of iodide of potassium.

Along with these conditions, we have one or other of the skin affections or eruptions. In secondary syphilis these are very numerous and various, and we often have them mixed together, such as the papular and pustular forms, being both present at the same time. There are four special kinds of eruption generally met with in the secondary stage proper, as distinguished from the tertiary stage. The papular are, *lichen syphiliticus;* the pustular, *ecthyma syphiliticum;* the squamous, *psoriasis syphilitica;* and the vesicular, *eczema syphiliticum*—the first two being by far the most frequent.

The papular form of eruption consists of pimples or raised spots scattered over the whole surface of the body in groups, sometimes absolutely confluent. The pimples are not very acuminated. On the top of each is a sort of vesicle containing a milky-looking serum, which in some cases appears very like pus. This form of eruption generally occurs in clusters, sometimes over the whole surface of the body, generally beginning on the chest, arms, and face, and passing thence to the lower extremities. The pimples generally fade away in from three to four weeks, first disappearing from one part of the body and then from another, leaving the site of the eruption covered with reddish spots, which also gradually disappear.

The pustular eruption consists of pustules of various sizes, which have a raised papular form, very like the preceding, but usually somewhat larger. In some cases the pustules are confluent, and so very much like those of smallpox as to be hardly distinguishable from them. The syphilitic pustules, however, are generally much smaller than those in smallpox; and besides, in the latter disease, the pustules go through a regular course, while in the former we have various crops of pustules coming out at different times, and, as these pass off, others come out elsewhere. This symptom will generally serve as a diagnostic between the two diseases. Both the papular and pustular forms of eruption are attended with some fever, sometimes with great febrile excitement. When the pustules fade away they leave a peculiar copper-coloured spot of a larger size than the original eruption. This copper colour is distinctly marked in all the syphilitic eruptions. The febrile excitement

is often well marked: the pulse is quick, there is sickness and vomiting, generally with headache, and sometimes with delirium. In other cases, as in lichen, there is no marked fever, though in every case there is more or less of a febrile state of the constitution.

The third form of eruption is the *Psoriasis syphilitica.* This forms red spots raised from the surface of the body, and varying in size from that of a pea to that of a sixpence. They have a sort of vesicle on the top, the base being of a bright vivid red colour, and they have rather the appearance of suppuration. The fluid exudes from below the surface, and the parts desquamate. We have the face swollen and covered over with the red spots, and a general irritation of the skin in the neighbourhood; and as the desquamation goes on the whole surface scales over. This condition was termed by the old writers the "true scaly-pox;" and it is this form of eruption, above all others, which follows upon the indurated chancre, and hence some would limit the term "true pox" to this form of disease arising from the true or hard chancre. The psoriasis syphilitica is attended with a good deal of constitutional disturbance. And in it also the syphilitic sore throat is most marked and severe, though in all cases of skin eruption it is present to a greater or less degree. The psoriasis recurs from time to time, and in the tertiary stage it sometimes becomes persistent and is very troublesome to cure; but when it is treated actively in the secondary stage, we can generally prevent or modify its recurrence.

The fourth form of eruption is the *Vesicular form;* this very often assumes a tubercular appearance. The vesicles are slightly rounded and elevated, and are filled with opaque serous fluid; the vesicle bursts and forms a dark crust, under which ulceration takes place. Sometimes the ulceration undermines the parts until it comes out from below the crust; at other times it gives rise to the serpiginous ulceration so often met with in syphilitic diseases. The crust formed is very marked, and when removed it forms again. In tertiary syphilis it is met with in its more distinctive forms. When the ulcerated crust is removed the surface presents a peculiar excavated, rounded, or serpiginous appearance, with no tendency in the ulcer to heal, and the crust forms anew. Sometimes the crust is very prominent, and so causes great deformity. This is the *rupia crustata.* It occurs chiefly in tertiary syphilis, which is merely a more advanced stage of the disease—there being no natural division between the secondary and tertiary stages.

Treatment of the Skin Eruptions.—The papular and pustular forms may occur after a soft chancre. The third or scaly eruption seldom occurs after a soft chancre, but almost always after the hard. During the irritable or febrile state the treatment must be nearly the same in all cases—viz. to allay the febrile excitement before using specific remedies. In this stage the stomach is out of order, the tongue foul and furred, and the secretions are often arrested; and before giving remedies like the iodide of potassium we must first get rid of these symptoms by the use of alteratives, purgatives, various diaphoretics, such as acetate of ammonia, along with an occasional opiate, keeping the patient at rest being of course important.

When we have to deal with the papular or pustular eruptions after the febrile condition has been got rid of, the surface assumes a dark brownish appearance, and then the best remedy—especially in the papular eruption—is the iodide of potassium, which is here really beneficial; it should not be given along with any other medicine, and it must be given in doses proportioned to the age of the patient; begin with three or four grain doses twice a day, and increase it gradually to five-grain doses, but not more. Under the use of the iodide the sore throat and the papular and pustular eruptions disappear very rapidly; the pains in the bones and joints, which are sometimes complained of, also disappear, and the patient is relieved from all uneasy symptoms. It is seldom, if ever, necessary—especially in the papular eruption—to have recourse to mercury, which at the most can only be required as an alterative to use with the iodide of potassium, which by itself is usually sufficient; but sometimes when the disease does not yield to the iodide of potass the mercury may be given, taking care of course not to push it too far. Mercury is apt to produce diseases very similar to those met with in the more advanced stages of syphilis, and hence there is always some risk in using it, and its effects in each case require to be carefully watched. When we do use the mercury, the best preparation to use is the iodide of mercury. The decoction of sarsaparilla may be given after the iodide of potassium, but I have no faith in it, though Mr. Lawrence—whose lectures on syphilis are well worth consulting—values it highly. When the eruption is beginning to fade, the use of a bath containing a little bicarbonate of soda is very beneficial; after a time add a little sulphur, but do not make the bath too stimulating. In some cases we require to use the weak nitromuriatic acid bath. The same acid given internally is also of great service.

In the treatment of the scaly eruption, I would always begin with the iodide of potassium, as in some cases, when given in large doses, it effects a cure of the disease; but at the same time it cannot be altogether trusted to, and therefore it must be combined with some alterative form of mercurial; and we find that in this form of disease even anti-mercurialists give a little mercury, but here, as elsewhere, its effects must be carefully watched, never allowing it to produce extreme salivation, and never giving either it or the iodide of potassium during the stage of febrile excitement, but only when the desquamation is taking place.

LECTURE XXII.

Secondary Syphilis continued—Condylomata and Warty Growths—Affections of Lips and Tongue—Phymosis—Fissures and Contractions.

Tertiary Syphilis: its effects on Periosteum, Bone, and Cartilage—Gummata—Congenital Syphilis.

There are certain other local affections besides the sore throat and the bubo which accompany the secondary stage of syphilis; they are sometimes mentioned as tertiary symptoms, but they are most severe during the secondary condition. These are—the different forms of condylomata and warty excrescences; a peculiar form of iritis; certain forms of cracks or fissures occurring in different parts of the body; affections of the lip and tongue, and a form of ulcer met with in the rectum; also syphilitic contraction of the rectum.

The *Condylomatous* is a very common form of secondary symptom. Sometimes it is considered as a primary symptom, but it is really a secondary condition, and it is not likely to produce a sore like a chancre. There are two forms of syphilitic condyloma: one, the warty condyloma, which is not unlike the ordinary gonorrhœal wart; the other or more marked syphilitic affection—the mucous condyloma. Both are of frequent occurrence, the warty condyloma being perhaps the more frequent in the female than in the male, while the mucous condyloma is very common in both sexes. Condylomata are met with, not only on the genital organs, but also near the anus, scrotum, and groin. Very generally the tonsils and throat, sometimes the lips, are also affected. The warty condyloma sometimes assumes a villous form of growth, and then closely resembles epithelial cancer. The mucous condyloma also often occurs at the edge of the lip, and forms there a fissure, or ulcer with a hard base, which, from the constant movement of the parts, becomes very irritable, and assumes the appearance of cancroid disease; and hence a correct diagnosis of these condylomata is very important, and for this reason in ulcers of the lip we should not be too hasty in operating. One guide to the diagnosis is, that true cancroid disease is not common, as a rule, in young people. The mucous condyloma is more characteristic of the pure syphilitic origin; it has a smooth mucous surface, with a hard raised base, and secretes a fluid, which, touching the neighbouring integument, seems to give rise to other condylomata. Coexistent with it there is often a condylomatous sore throat, which is a chronic condition, and is quite different from the acute syphilitic sore throat.

The mucous condylomata may be got rid of very readily by local

treatment only, such as dusting calomel over the condylomata, which will cause them to disappear without leaving any tendency to the reproduction of the disease. When the condylomata resist the calomel, they can generally be cured by applying locally a strong saturated solution of sulphate of copper, or, better still, rubbing them with the solid sulphate of copper, though this is a much more painful remedy than the calomel. But we can hasten the disappearance of the condylomata by giving internal remedies, such as the iodide of potassium in pretty large doses, or a few doses of grey powder, taking care not to carry the latter very far. We sometimes find that patients suffering from condylomata are very weak and exhausted, and in these cases the use of mercurials is contra-indicated. Here we require to restore the general health, and trust to the local treatment; and afterwards, when the patient becomes stronger, we may give the iodide of potassium or grey powder.

The calomel is not so efficient in the case of the warty condylomata as it is in the mucous condylomata. In the former the strong acetic acid or chromic acid, applied upon the surface, is more useful. But when they are very large and numerous, it is better to remove the warts by operation, along with part of the integument from which they arise, perhaps touching the parts, after the removal, with a little sulphate of copper; although there is not much fear of the cut surface taking on the diseased action.

Another condition met with, both in the primary and secondary stages of syphilis, is one which may also occur as a congenital affection —*Phymosis.* When it exists along with or is consequent upon a chancre, it is very troublesome to deal with, though, if it be seen in the early stage, and if there be no congenital phymosis, it can generally be got rid of readily; but in many cases the part beyond is swollen, and often there are a number of sores existing within the prepuce, and, if left to itself, the unhealthy discharges are confined, and the diseased action often destroys the prepuce, though at other times the condition may pass off without treatment.

When the phymosis is so decided as not to allow of the prepuce being drawn back, the best treatment is to introduce a director beneath the prepuce, close to the side of the frænum, and with a bistoury slit up the prepuce to its whole extent. When this is done, we see the position, extent, and number of the sores, if the condition has existed for some time; and if there be a large sore on the prepuce, or if a number of small chancres be present, the best treatment is to circumcise the patient, by cutting off the prepuce higher up with a pair of scissors. One objection made to this plan of treatment is, that the cut surface left is apt to take on a chancrous action; but the same objection applies to the slit made in cutting open the prepuce, which is a necessary operation, and the risk of bad results after the circumcision is not much greater than if the prepuce had only been split up. After removing the prepuce, we may touch the surface with nitrate of silver, to prevent the unhealthy action taking place; but that is sometimes apt to irritate the parts. After circumcision there is usually a good deal of bleeding, and we require to tie some of the larger vessels, and then apply cold-water

dressings to repress it, and afterwards treat the chancres in the usual way. If there be a chancre situated near the frænum, which does not heal readily at the first, but goes on increasing in size, then the best thing to do is to divide the frænum, otherwise the diseased action destroys it ultimately by the ulcerative process, and the chancre may ulcerate into the urethra. After cutting the frænum the sore will heal readily. Here also we must watch against hæmorrhage, not so much at the time, but from oozing afterwards, when the irritation causes the penis to become semi-erect, as it often does. Cold-water dressings, or ice, will, however, be sufficient to repress the oozing of blood.

Fissures or cracks as symptoms of secondary syphilis occur about the edges of the nails and between the fingers, at the edges of the lips and on the tongue, and by the side of the rectum, where they assume all the appearances of fissure of the anus, but not healing so readily under treatment. In the tongue these fissures are very common, and when of long standing they assume characters very like those of cancer. In one case of this kind every remedy had been tried, both locally and constitutionally, but without avail, and I began to consider it a case of cancer supervening upon syphilitic affection ; the patient was suddenly seized one night with urgent dyspnœa, for which tracheotomy was at once performed, and immediately afterwards the ulcer in the tongue began to heal rapidly ; in this case all the marked appearances of cancer were present, but when once the source of irritation was removed the true nature of the disease was evident. Sometimes we may require to divide the fissured ulcer of the anus, as is done in ordinary fissure of the anus, but as a rule this is to be avoided, unless there be very great pain ; it is better to apply nitric acid or nitrate of silver on the surface, and give iodide of potassium or the iodide of mercury or grey powder internally.

Tertiary Syphilis.—It is very difficult, in fact almost impossible, to draw a line between secondary and tertiary syphilis, and say definitely when the one ceases and the other begins ; we must judge in great measure from the appearance of the patient—the secondary symptoms may show themselves even before the primary sore is healed. The tertiary symptoms generally occur some considerable time after the chancre has healed, and after, it may be, several attacks of the secondary condition, and the symptoms are generally most marked when the patient's health has begun to deteriorate from some other cause. So long as the patient is well nourished and taken care of, the tertiary symptoms may be altogether absent or very much modified, even though the primary and secondary conditions have been very severe ; but on the other hand the patient may have very slight secondary symptoms, perhaps none to attract attention, and yet suffer from tertiary symptoms.

In the tertiary stage pains are felt in the joints and long bones, with rheumatic pains in the head and intense headache, and occasional attacks of sore throat. Constitutional or cellular-tissue ulcers, as they are termed, occur in different parts of the body. These ulcers present the appearances already spoken of—namely, either a circumscribed exudation round a hollowed-out sore, with unhealthy-looking surface, sometimes very irritable, or showing a tendency to burrow, or they may

assume the serpiginous form, the whole limb presenting the appearance of a mass of ulcers which blend into one another. In these cases we almost invariably find that the constitution is debilitated from some previous cause, either from an extremely scrofulous diathesis, or from the effects of large doses of mercury, or very generally from a combination of these, with dissipated habits or other causes of weakness. The symptoms met with in tertiary syphilis are constitutional ulcers, inflammation and pain in the bones, and the formation of granular nodes. Under the periosteum there may be a feeling of fluctuation and a raised swelling; if an opening be made at the part a few drops of unhealthy pus escape, but a considerable amount of exudation still remains, and the part is certain to ulcerate and expose unhealthy bone below; this condition is termed the syphilitic periostitic abscess, and it ought never to be opened if we can possibly avoid doing so.

Again, in the head there is intense rheumatic or periostitic headache. Ulcerations of the scalp take place, attended with unhealthy gummatous exudation into the scalp tissue, and the connective tissue between it and the pericranium; a large ulcer is formed by the union of several smaller ones, and at the bottom of it is a quantity of bare carious bone, constituting what is termed corona veneris. The disease may affect the membranes of the brain, and so give rise to cerebral symptoms, and ultimately prove fatal.

Gummata.—The peculiar masses of tubercular-looking material exuded into the connective tissue of different organs, or forming circumscribed swellings, termed *Gummata*, constitute a marked feature in tertiary syphilis. They are met with in the skin, mucous membranes, bones and muscles, and in the liver, kidneys, and lung substance. In the last-named organs the deposits closely resemble the ordinary tubercle. In certain positions, as in the substance of muscle, in the connective tissue around it, these gummata occasionally assume the appearance of true tumour-growth; and from their comparative rapidity of development—their consistence combined with the cachexia present—may be readily mistaken for medullary tumour. I have seen some cases where, except for the history of the case, it would have been almost impossible to decide the true character of the tumour. The growth disappears quickly under constitutional treatment, and therefore in doubtful cases a little delay and the use of internal remedies and local discutients are advisable. In one case where the gastrocnemius and soleus and periosteum of the tibia were affected, the deposit had assumed all the characters of a medullary cancer; but the history of the case raised doubts in my mind, the limb was saved, the tumour and cachectic state gradually disappearing under mercurials and iodide of potassium. Recently I had a similar tumour of the vastus internus.

Besides these diseases of bone, there are also affections of the larynx met with in tertiary syphilis, such as ulceration of the larynx, which may also occur as a secondary symptom; though in the tertiary stage it is much more severe, and generally affects the cartilages of the larynx as well as the mucous lining, producing a form of necrosis of the cartilages similar to the cario-necrosis of the bones of the head. This condition often requires the performance of tracheotomy to obviate the risk

of suffocation. Different forms of skin eruptions are also met with in the tertiary stages, such as the rupia crustata, ptyriasis, and psoriasis, but they are essentially the same as in the secondary stage of the disease.

In the treatment of tertiary syphilis I trust very much to the iodide of potassium as an internal remedy. Mercury, if it can possibly be avoided, should not be given. The nutrition of the patient, however, is the most essential part of the treatment in this stage, and if there is not much irritation present, some wine or other stimulant should be given. The iodide of potassium may be exhibited in five-grain doses twice or thrice a day, and should be continued for some time. If, by itself, it does not produce very beneficial effects, Fowler's arsenical solution may be given along with it, though the iodide and the arsenic should not be mixed together, but taken separately, so that one or other may be discontinued if necessary. Our chief object in the treatment of tertiary syphilis is to get rid of the debilitated condition which characterises it, by means of proper nourishment, the use of fresh air, change of occupation, and of scene, along with tonics, such as quinine, cod-liver oil, and preparations of iron. When once the general health is re-established, very little medicine will be required to cure the syphilitic symptoms.

The subject of Congenital Syphilis is one of great interest in many respects; but in a course of lectures on surgery it is impossible, due regard being had to other subjects, to enter on it further than to describe its general symptoms and treatment, so that you may be able to recognise the diseased condition and adopt the proper measures for its cure when you meet with it in practice; and this I shall do very briefly.

By congenital syphilis we mean syphilis contracted by a child during intra-uterine life. The transmission of the disease to the fœtus may be due to either the father or mother, or both being syphilitic at the period of conception, or the mother may contract syphilis during gestation, and transmit it to the fœtus. The child is usually weak and shrivelled at birth, and continues to have a dwining appearance, and very generally it has a peculiar snuffling breathing, accompanied with discharge of offensive mucus from the nostrils, and irritation about the eyes and eyelids. Soon after birth, affections of the skin and mucous membranes begin to show themselves in the form of cracks and ulcerations or swellings at the orifices of the mucous canals. One of the most characteristic symptoms is the occurrence of mucous tubercular patches on inside of the thighs, the nates near the anus, or on the sides of the vulva in the female, or scrotum in the male. These patches are of a brown or red colour, of copper tint, slightly elevated; occasionally they are of a dull white colour, and vary in bulk from the size of a split pea to that of a shilling. They are often very irritable, and exude a thin moisture or discharge, and are of the nature of condylomata.

The cutaneous eruptions are most usually either pustular or vesicular —ecthyma and eczema are common; the papular and squamous are less common. In children who have been affected by congenital syphilis, the teeth generally undergo a crumbling decay at an early

period, the central incisors of the upper jaw being usually the first to give way. This degeneration affects the permanent, as well as the temporary, teeth, the former being usually short and pegged. As the patient grows up, he is subject to chronic pains in the bones and joints, and sometimes a peculiar joint affection closely resembling white swelling, which, however, is more amenable to appropriate treatment. If the patient be of a strumous diathesis, all the constitutional symptoms become more serious.

Treatment.—Looking to the dwining, weakly, and irritable state of the infant, you might think congenital syphilis a very hopeless disease for treatment, and yet I know few diseases where appropriate remedies, judiciously exhibited, and combined with nutritious diet, so rapidly effect a change for the better in the state of the patient. A few doses of grey powder produce almost marvellous results. The marasmus or wasting is arrested, the child begins to take food, nutrition goes on, and the skin-affections and condylomatous patches on the nates or genitals begin to disappear under the action of the medicine; or if the condylomata prove obstinate, dusting them with calomel, or the application of sulphate of copper, either in solid or solution, speedily effects their removal. The calomel is the preferable application as being devoid of pain, and it is very effectual; it should be puffed upon the affected part from a small India rubber injecting-bag, so that it is applied in the form of an impalpable powder. Inunction with weak mercurial ointment has been recommended as preferable to giving grey powder or other mercurials internally, but I have found the grey powder so simple and efficacious that I have never tried any other alterative remedy. It seldom requires to be given for any length of time, and so soon as the infant begins to gain flesh and to take food, and nutrition is fairly established, little or no treatment is required, except, perhaps, local applications. Salivation is not to be looked for, indeed it is almost impossible to salivate an infant, nor is it desirable; all that we want is a slight alterative effect of the mercury, and that is sufficiently gained by a few doses of two grains of grey powder. In regard to nourishment—in reality the most important part of the treatment—a healthy nurse should, if possible, be obtained, or, failing that, goat or ass milk, or cream and whey with a small proportion of sugar, given in preference to farinaceous food. As the child grows up, beef-tea, essence of beef, and cod-liver oil, may be given if they agree with the digestive organs. In very weak infants we may, from the first, require to give wine in the form of white wine whey, or even brandy and water, till nutrition is established. Sponging the body with some tepid weak alkaline wash, such as a drachm of carbonate of soda to half-a-gallon of rain water, will be found beneficial in improving the general health as well as the state of the skin, which always requires attention even after the eruptions disappear.

LECTURE XXIII.

Wounds: their Nature and Classification—Incised Wounds: mode of Infliction; Appearance—The circumstances which modify or aggravate their Severity—Treatment of Incised Wounds—Arrestment of Hæmorrhage—Cleanliness—Apposition of Severed Surfaces—Position of Part—Sutures—Local Applications—Danger of Undue Pressure—Regimen and Diet.

In a former Lecture I alluded to the healing process, and dwelt on the distinctions between and the conditions affecting primary and secondary union. It will be useful for you to remember these particulars, now that we are about to consider the various solutions of continuity of the surface and deeper parts of the body.

Wounds are classified under the following heads:—*Incised*, *Punctured*, *Lacerated*, *Contused*, *Gunshot*, and *Poisoned*.

We shall first consider the Incised. This is the simplest form of wound, and includes most of those made in surgical operations. It is inflicted by a sharp cutting instrument, and the textures are divided evenly and smoothly; there is therefore no tearing, bruising, or twisting of the parts, and hence the incision is attended at first by smart hæmorrhage, more so than most other forms of wound. This results from the vessels being cleanly divided, so that the hæmorrhage proceeds until they retract within the cellular tissue, or until the system becomes affected by faintness from loss of blood.

If the wound has been made parallel to the axis of the limb, and to the course of the subjacent muscular fibres, there is no gaping of the edges so long as the part is kept in position; but if the incision be transverse to the axis of the limb, or if it has divided transversely the subjacent muscular fibres, then the wound will gape, and the deep part more largely than the superficial, owing to the retraction of the divided muscular fibres. If the muscles so divided be deeply situated, a cavity will be formed in which blood and other discharges are apt to collect, and so complicate the treatment. For example, suppose a case in which a person has received a superficial longitudinal wound along the front of the thigh, it will gape very little if the limb be kept in a straight position, because the margins of the wound keep in contact; but if the wound be deep, and the muscular fibres transversely divided, though the edges of the wound may lie together superficially, the deep part will gape and form a cavity in which blood and discharges will accumulate.

Treatment of Wounds.—The history of surgery contains no stranger chapter than the singular changes which from time to time have taken place in regard to the treatment of wounds. If we go

back to the quasi-scientific age, when learned physicians laid down rules for dressing wounds *more canonico*, we find it was considered essential that every wound should undergo certain regular stages, "digestion, mundification, and incarnation," and no wound was allowed to heal by first intention. After amputation by the circular method, the cavity of the stump was stuffed with charpie soaked in aromatic spirits, or balsamic lotions, to prevent putrescence; and, in flap amputations, the section of the limb and the flap were dressed separately until granulation took place. Into every deep wound tents or leaden tubes were thrust, to keep open a track for discharge to escape. We are at first apt to wonder how or on what principle such treatment could have been adopted, and how, in only a somewhat modified form, it continued to hold its place until the time of Hunter, and, in some places, until a much more recent period. Yet its first beginnings were probably the result of observation of certain cases or forms of wound, and used exceptionally, until, in course of time, from mere routine practice, it became exaggerated and used in all cases.

Most practical surgeons will admit that, in wounds implicating textures possessing different degrees of vitality and physical conformation, as in amputations, it can hardly be expected that all the divided structures should heal with equal rapidity, or in the same way. Whilst the skin and softer textures generally do so speedily, the denser and less vitalised textures, such as bone and tendon, must undergo changes of slower character; and, situated as these are deeply in the wound, serous and bloody discharges are liable to collect around them, and, when the soft textures have united throughout by first intention, these bloody or serous discharges, being prevented from escaping, may, and often do, lead to deep-seated irritation and suppuration, and hence the revived use of drainage-tubing in many cases in the present day. Such considerations probably at first led to the use of tents and the other parts of the system; and the amount of discharge arising from the method of dressing seems only to have served as an argument for the necessity of keeping the wounds open to allow its escape. Then we must recollect that at that time surgeons acted merely as hands to the learned doctors, and to have ventured to have gone against the canonical authority was to be branded as a quack; and so the men who saw most of the dressing of wounds either kept silent, or became the itinerant operators to whom we owe no small debt for the simplification of dressing wounds and of operations.

Even when the simple method of healing wounds was introduced, it was seldom professed openly. It was always ornamented with a judicious touch of the mysterious or philosophical as it was called. Perhaps no truer enunciation of the principles of the treatment of wounds has ever been made than that of Paracelsus, who was one of those who ventured to oppose the orthodox physicians. "It is the nature of flesh," says he, "to possess in itself an innate balsam which heals the wound. . . . Nature hath her own doctor in every limb; wherefore every chirurgeon should know that it is not he, but nature who heals. What do wounds need? Nothing. . . . So the surgery of wounds is a mere defensive to prevent nature suffering from

any accident from without, in order that she may proceed unchecked in her operations." Yet Paracelsus thought it necessary to invent a sympathetic powder to recommend this method to the public. Mr. John Bell, in his remarks on wounds, says, "We find no one surgeon in Europe who ventured to unite wounds directly by adhesion, without pretending to have learned from some eastern sage, or to have found out by deep studies in philosophy and alchemy, a sympathetic, or as they often called it, a philosophical cure of wounds," and he is very severe on what he denounces as pretences of philosophy or science "to make sure of rousing at least one-half of the learned world to combat in their behalf." Perhaps he is too severe in denying them the title of philosophical. If "the proper study of mankind is man," then assuredly on that important study these men had founded their philosophy. They had noticed that patients in general feel rather flattered by something special being done, some little halo of mystery to brighten their sufferings, and give importance. They saw that for one "Good Hezekiah" who meekly submits to so simple an application as a "poultice of figs," they would meet with a dozen Naamans "ready to turn away in rage" if there were not "some great thing" done, or some fuss made about their cases; and so, whilst they treated the wounds simply or left them to nature, they amused and distracted the attention of their patient by enacting various little incantation scenes or mysteries. Some, like Paracelsus and Coldbatch, applied their sympathetics locally to the wound in the forms of vapour, powder, or constrictive plasters. Others still of higher philosophical type, like Sir Kenelm Digby, did not trouble themselves to see the patient, but merely some blood-stained rag from the wound, or the weapon that inflicted it. On these they bestowed all their care and attention, merely requiring that the patient should keep his wound "clean and cool." They had their failures like others, but their philosophical theory enabled them to account for them. Something had been overlooked in bringing them the bloody rag or weapon, and so "the finer spirits had escaped," and, of course, the failure was an accident, and no fault of the system. Were I the patient, I would decidedly prefer that the surgeon should bestow his attention on the blood-stained rag, leaving the wound "clean and cool," or swathe the knife which had inflicted the wound in any amount of cabalistically-prepared bandages, rather than he should wrap up and overheat the wound with fold after fold of dressing and greasy cerecloth bandages, compressing the parts and confining the bloody and serous discharges. In a word, I would rather that his incantations were performed on something else than my wound. The truly philosophical views of the adhesive process, taught by John Hunter, gradually led to clearer notions as to the requirement of wounds and the principles on which their treatment should be conducted; and nowhere were these views more fully and intelligently carried out into practice than in this city, mainly through the influence of the writings of John Bell, and subsequently by the treatises of Liston and Syme on the treatment of incised wounds. The principles laid down were simple: thorough cleansing of the cut surfaces, waiting until all oozing had ceased and the surfaces glazed with lymph, before uniting them finally by sutures;

cold applied for some hours to moderate excited action, then light dry dressing, and no interference with the wound except what was required to keep it clean. But, at the same time, great attention was paid to the general state of the patient. The results obtained were excellent, and, until recently, this has been the system in use here. But simplicity has sources of failure, for it is apt to lead to carelessness in dressing.

We are again in a transition state in regard to the treatment of wounds. The antiseptic method (as it is termed) of my esteemed colleague, Professor Lister, whatever may be its merit, is being pressed in some quarters to the exclusion of conditions which I think at least equally, if not more, important in the treatment of wounds and operations. I have no intention to discuss the theory as to production of putrescence by germs from without, or whether that condition may not also arise from within, owing to certain states of the blood and general system; nor yet as to the comparative value of the different antiseptics at present contending for pre-eminence. But some of the statements advanced in favour of the antiseptic system so ignore the success obtained by simple dressing and treatment of wounds, or assert such an amount of infallibility as to the curative powers of the special method, as to require notice. When I read statements to the effect, "that the antiseptic method is to be regarded as one of the most important contributions to modern practice, inasmuch as it makes wounds heal by first intention, instead of going through the painful process of granulation and suppuration," I can only regard such statements as arising from want of experience in, or misrepresentation of, the simple method of treating wounds; for assuredly healing by granulation is neither the object nor yet the general result of that treatment. Suppuration, I believe, is not unknown under the antiseptic method, whilst the average duration of treatment is certainly not lessened. But when I find a German professor and hospital surgeon stating that, after a year and a half's experience of the antiseptic treatment, he is able to guarantee with certainty a perfectly successful result to his operations, such assertion challenges closer examination, demands proof, and forces me to ask the question, How far, apart from other conditions, do different modes of dressing stand in the relation of cause to successful results? The answer to this important question must rest on sufficient data and carefully-weighed statistics. It will not suffice to point to some brilliant results in individual cases, because all methods of treatment can produce that kind of proof; nor will it do to state that no deaths from pyæmia have occurred under the system. At one time that term was never met with in the bills of mortality, and it is rapidly disappearing now. The statistics for proof must indicate the nature of the disease or injury for which the operation was performed, and the cause of death in fatal cases (for deaths still occur), not by a conventional term, but by giving the symptoms during life, and the organic lesions found after death.

With extensive statistics of this kind, we would be better able to judge of the comparative advantages of different systems of treatment. At present all is assertion or reference to special cases, or to the not very definite statistics of foreign hospitals, and it is not a little curious

that we hear most of the success from abroad. I think sufficient time and scope have been given to the antiseptic system in this country to enable those who use it to furnish statistics such as I have indicated, and thus to enable us to judge more dispassionately of its real merits. In comparing of late the results of my own hospital practice, I have been struck with the success which attended very simple treatment, and this leads me to question our progress in departing from such treatment for more complicated methods. Thus I find that, during a period of three years, out of sixty-three major amputations for disease, there were only three deaths; and of twenty-three cases of excision of joints, only two deaths, at a time when the treatment consisted in thoroughly cleansing the cut surface by pouring tepid water over it, and occasionally applying tincture of iodine alone, or diluted, on the flaps; whilst the dressing consisted merely in laying a veil of lint or thin muslin over the stump. Again, when preparing statistics of my amputations for my published lectures, I found evidence that certain conditions, such as the nature of the disease or injury necessitating the operation, had most important influence on the result; such influence, indeed, as I could not have supposed until the statistics brought it distinctly before me, and my later statistics corroborate my former; so that I cannot accept the statement that any method of dressing, however good, will ever enable us to guarantee success. Whilst I speak of the antiseptic system, meaning the special method, I need hardly say that all surgeons have for their object the avoidance of putrescence, though their views may differ as to the best way of attaining their object.

The treatment of incised wounds is very simple, the object being to promote immediate union, or union by the first intention. A certain amount of excited action is necessary to lead to exudation of plastic material for the purpose of agglutinating the edges of the wound at first; afterwards, this material becomes organised and forms a permanent fibrous texture or cicatrix. To favour the process of union by the first intention, there should be as little separation of parts as possible, so that there may be no deformity, and that the usefulness of the part be not destroyed. Hence all foreign substances between the cut surfaces should be removed, and the edges kept in close contact and at perfect rest. Excited action must be controlled within moderate limits, though a certain amount of it is salutary, because by it the plastic lymph is thrown out more abundantly.

Hæmorrhage, whether venous or arterial, must be arrested; and this is the first thing which the surgeon has to attend to. If a small artery be partially cut, blood of a bright red colour spirts out in a jet; but if the vessel be completely cut across, the ends contract and retract within the cellular tissue, and the bleeding ceases. When the hæmorrhage is arterial and proceeding from a wound of one of the limbs, a temporary arrest may be obtained by digital compression of the main artery, or the application of a tourniquet above the wounded point; a very ready and efficient plan is to encircle the limb two or three times tightly with elastic india-rubber tubing. In all cases where the bleeding is at all profuse, one of these methods should be employed before proceeding to arrest the hæmorrhage permanently.

At the extremity or angle of a wound, where the vessel may be merely cut into, and only partly divided, the bleeding will in some instances continue, or take place from time to time, and so prove serious. In such cases the best plan is to extend the incision so as to divide the vessel completely. This enables us to see the divided ends which before were concealed, and, if necessary, a ligature can be applied; though, generally, this will not be necessary, as the bleeding will probably cease very soon. So long as the vessel is only partially divided, it cannot retract within its sheath; but when cut through, the retraction takes place, and the hæmorrhage is arrested naturally. In cases where the wounded artery is small and difficult to get at for the purpose of ligaturing it, or where from the state of parts the vessel will not hold a ligature, a graduated compress will sometimes answer the purpose; the small end of the pyramid of lint thus formed being placed upon the wound in the artery, whilst pressure is exerted on its base by a bandage tightly applied.

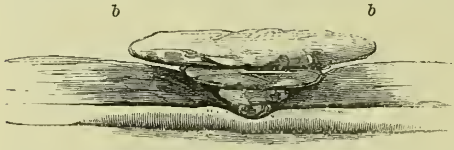

Fig. 14.

Venous bleeding is generally easily arrested, if we attend to position. A good deal of it—especially after operations—depends on unequal pressure from bandaging or position, by removing which the oozing of blood will cease. Even when a large vein has been wounded, a little compression with a piece of lint, attention to position, and exposure of the wound to cold, will generally prove quite sufficient to arrest the bleeding; but if not, we may tie the vein, or employ acupressure. Generally, there is no necessity for tying a vein, but the danger of doing it is not so great as is generally supposed—especially after amputation—as I have repeatedly proved in my own practice.*

After the bleeding has been arrested, all clots and foreign substances must be removed from the wound. It might be supposed that an incised wound was not likely to have any foreign body in it. Nor has it when made by the surgeon. But in other cases the wound may be filled with dust and dirt, from the patient falling and struggling on the ground after receiving the wound. In every case a full stream of tepid water, mixed with a small proportion of carbolic or boracic acid, should be poured over the cut surface until it is quite free from blood clots, and any that adhere should be removed either by a sponge or by the point of the finger, so that the wound may be thoroughly clean.

When all oozing has ceased, the next point to be attended to is position, and the bringing of the parts into accurate contact. Here the direction of the wound must be considered. If the muscular fibres be deeply divided, it is as well to allow the wound to remain open

* Natural and artificial hæmostatics will be fully discussed in the lectures on injuries and diseases of the vascular system.

Fig. 14. Plan of a graduated compress. *a*, The artery wounded ; *b*, *b*, the graduated compress, arranged so that the apex of the cone is in immediate contact with the arterial orifice, while its mass occupies the general wound, and projects somewhat above the integumental level.

from six to eight hours, merely covered by a piece of lint soaked in boracic acid lotion and kept moist with it, or if we employ sutures, we should leave them loose, so that they can be easily tied afterwards. At all events, we leave the wound so far open that the blood and serous discharge may escape; and after a few hours we may wash out any clots, and bring the edges accurately together, and so secure them. This is to be done partly by sutures or plaster, partly by attention to position. If the wound be parallel to the axis of the limb, we simply place the limb in an easy and natural position, and put in a few sutures about an inch or so apart. The edges will unite readily enough if we leave them uncovered. If the wound, however, be transverse to the axis of the limb, it is as well to relax the muscular fibres, so as to leave as small an interval between them as possible. We must also prevent any accumulation of blood or discharge into the cavity of a deep wound, by leaving the most dependent point of the incision open, and, if necessary, introducing a portion of drainage-tubing to enable us to wash out the cavity, using at the same time properly applied compresses and bandaging, with silver wire, catgut, or silk.

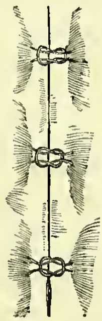

Fig. 15.

Various forms of suture are employed in keeping the edges of incised wounds together. The ordinary *Interrupted suture* is the most common. If the sutures cause any irritation they should be at once removed; and in doing so, it is better to remove the lateral sutures, leaving the central one in, than to remove the central ones. If the irritation caused by the sutures be very great they should all be removed. The *Harelip*, or *Convoluted suture*, is also sometimes employed. The needles should be passed deeply through the parts, and introduced at least a quarter of an inch from each edge. Slightly waxed thread is the best substance to use with the needles, and as little pressure as possible should be applied. The needles are withdrawn about the fourth day, so as to prevent any irritation being caused by them, though, in some cases, they may be left in much longer. When we want to apply pressure on the deep as well as on the superficial part of the wound, the *Quilled suture* is employed. It is often used in cases of ruptured perineum, where, by passing needles deeply, we keep the deep parts together, and by one or two interrupted sutures the edges are brought into close contact, for when the two pieces of quill or wax-bougie are placed in position, and the threads tied, the effect is slightly to avert the skin margins of the wound. When the injury is superficial, sutures are not required at all—strips of plaster are sufficient. It is only when there is any great depth or extent of wound that they are necessary.

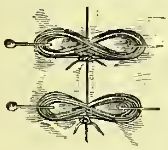

Fig. 16.

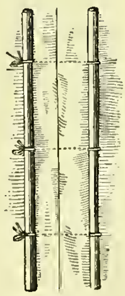

Fig. 17.

Fig. 15. The ordinary interrupted suture. The knots not tightened.
Fig. 16. The harelip, or convoluted suture.
Fig. 17. The quilled suture. The dotted lines mark the course of the wire beneath the integument.

As to local applications to incised wounds, many substances were formerly used to favour adhesion and prevent unhealthy action, such as Friar's balsam (the compound tincture of benzoin) and Arquebuzade, an aromatic spirit of rosemary. The former of these constituted a sort of varnish, and acted as a foreign body. The latter, which coagulated the albumen and glazed over the wound, answered better.

In my own practice I generally apply a piece of waxed paper which has been dipped in carbolic acid lotion, and over that a layer of carbolised or boracic lint. In cases, as after removal of tumours, where the parts are healthy and in a favourable state for union and the wound of moderate size, a layer of lint, wetted with boracic acid wash and kept moist, often answers all purposes, and need not be removed for some days unless bleeding or some untoward cause necessitate its removal. In larger and deeper wounds, whilst the greater portion of the incision should be closed by silver or catgut sutures, the most dependent end of the incision should be left open to prevent bloody or serous discharges collecting, and to enable us to wash out the cavity by gently syringing it occasionally, or a piece of drainage-tubing is introduced with the view of effecting the same purposes. I find the waxed paper useful, as it prevents irritation of the skin, or the dressing from adhering to the incision, whilst it allows serous or other discharge to escape from, instead of collecting in, the wound or on the dressing. In large wounds after surgical operations, where there is a risk of suppuration occurring, and where we cannot expect the adhesive process to take place throughout the whole surface of the wound, or where there still remains on a flap part of the pyogenic membrane of an abscess, the tincture of iodine painted over the surface is very beneficial. Under the use of iodine the suppuration is arrested or diminished, and a more healthy action is excited. Another application I at one time used was carbolic acid in methylated spirit; but I have found the iodine to answer better. After the removal of malignant growths, a weak solution of chloride of zinc (1 part to 30) may be used with advantage. For the first six or eight hours, dry cold, as ice-bags, may be used; but this must not be applied too long, as it may do harm. Afterwards the wound is left uncovered; a piece of lint is laid lightly over the surface. The lint, during warm weather, may be sprinkled over with strong spirit of rosemary, or chlorinated wash, or carbolic acid, so as to prevent putrescence.

In wounds of joints I have found great benefit from the use of dry cold—ice, in gutta-percha bags—over the part, so as to keep the temperature very low. When this plan is adopted, the cold must be kept up continuously, or the reaction will do more harm than the irregular application of cold will do good.

At one time surgeons used to apply pressure to a wound by plates of metal or wood, so as to keep the parts in close contact and prevent all movement. This was trying to force nature, and often produced much interruption to the circulation, brought on inflammatory action, and sometimes led to sloughing in a flap instead of union. Beyond inserting sutures, and occasionally applying gentle support by means

of a bandage, the less meddling the better; any attempt to force the parts into contact will assuredly do harm.

In wounds which are suppurating, the principal point to be attended to is extreme cleanliness, and the simple dressings should be so arranged as to be easily undone and to allow the free escape of discharge, which by its absorption might give rise to serious constitutional disturbance. In order to effect these objects, all wounds which are deep and discharging freely should be dressed twice a day at least, and at each dressing the wound syringed out very gently with a solution of carbolic or boracic acid, used of a strength which gives rise to no irritation of the wound. So soon as the wound begins to granulate, in addition to cleansing it thoroughly some stimulant lotion is used, such as a solution of chlorinated soda (one part liquor to twenty parts water) or sulphate of zinc (two grains to the ounce). Clean dressings are applied each time the wound is dressed.

When granulation is going on, instead of using the waxed paper, a strip of lint soaked in a stimulating lotion and applied to the wound often proves of great service in the healing process. When the granulations are strong and healthy this may not be required, and under these circumstances the use of the waxed paper may be continued.

Should redness appear at the edges of a wound, stitches which seem to be giving rise to tension are at once removed, and strips of adhesive plaster substituted, so as to give support to the flaps. The plasters are applied between the stitches, because, if they were placed over the holes made by the sutures, when suppuration occurs the discharge from these holes would be prevented. At the same time, a single ply of lint dipped in warm water is put over the wound. This must not be covered by gutta-percha, as, by so doing, the moisture is confined and the parts rendered sodden and weak. The lint is changed frequently. This treatment generally soothes the irritation, and the redness subsides. If the wound show a tendency to become dirty or sloughy, the surface may be touched lightly with solid nitrate of silver, and then the application of lint soaked in charcoal and water of a thick consistence is had recourse to. This is much more easily applied than the charcoal poultice; it allows the discharge to get more freely away, and it generally has the effect of cleansing the surface of the wound and causing it to take on a more healthy action. When a deep wound, such as a stump, has healed to a considerable extent and has cicatrised at some places, in dressing the remaining superficial sores, pieces of lint exactly the size of the sores are dipped in some stimulant lotion, and after being applied to the ulcers, are covered with pieces of gutta-percha a very little larger. If the wounds need no stimulation, small pieces of waxed paper cut exactly the size of the wound are sufficient; but if, on the other hand, the granulations are weak and exuberant, the application of solid sulphate of copper proves very beneficial. In no case should the dressings be applied over the cicatrised parts, for by so doing the cicatrix is softened and tends to break up.

The regimen should be carefully attended to—the diet should be

light and nourishing. After operations, or after severe wounds, an opiate should be given immediately to allay pain and shock, and procure rest. When the pulse rises high, antimony may be given along with the opium, so as to diminish the force and frequency of the heart's action, determine slightly towards the skin, and allay fever. In cases where antimony cannot be given, from its causing great nausea, aconite is very useful as a sedative. It may be given in half-drop doses of Fleming's tincture every three or four hours. When the pulse becomes moderate, the aconite should be discontinued. After a few days, a more generous diet should be given, especially after severe wounds or operations. A great error is committed by continuing a low diet too long. The stomach gets out of order, the patient becomes irritable, nutrition is not kept up, and the wound does not heal, but suppurates. A small amount of solid animal food ought to be given very soon after an operation; it is less likely to excite irritation, and more likely to be easily digested than a larger quantity of slops.

The sutures should be removed according to circumstances—some of them, perhaps, about the fourth day. When they are removed, slips of plaster should be applied, so as to give some support to the parts, though not exactly at the points where the sutures were, as there may be a slight tendency to suppuration at these points, and the plaster would prevent the matter from escaping. The slips of plaster should be short, so as not to cause any traction, but merely to support the margins of the wound in apposition.

Note.—A description of Professor Lister's special "Antiseptic Method," will be found at page 206, after the Clinical Cases of gunshot wounds.

Fig 1.

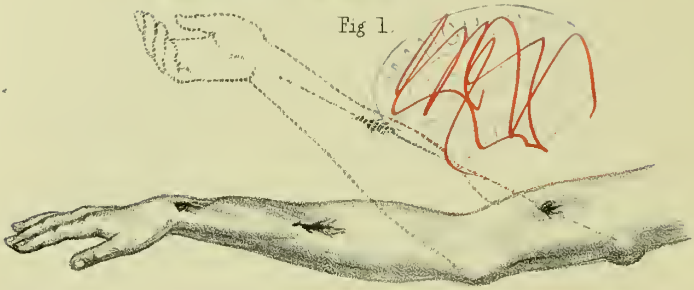

Fig. 2.

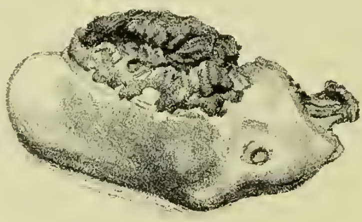

Fig. 3.

Fig. 4.

LECTURE XXIV.

Punctured Wounds: the special Dangers attending them, such as Erysipelatous Inflammation; softening of the Muscles and Pyæmia—Treatment of Punctured Wounds: by Rest; Application of Cold and Antiphlogistic Regimen; by Dilatation—Contused and Lacerated Wounds: Nature and Treatment of Contusions—Lacerated Contused Wounds: how produced—Risks of Tetanus and Secondary Hæmorrhage.

PUNCTURED WOUNDS are inflicted by thrusts, the point of the weapon penetrating, and the blade or body following, and separating the tissues like a wedge, rather than like a cutting instrument. The purest form of punctured wound is that produced when the point of the weapon is sharp, and the blade rounded or blunt. Examples of punctured wounds are those made by the trocar in surgery, or by weapons such as the bayonet, rapier, or pike, where there is little or no cutting of the textures (plate vii. fig. 4).

A wound inflicted by such weapons has the following characteristics: —Its depth is greater than its superficial extent. As the parts have been thrust aside rather than evenly divided, there is more or less contusion and ecchymosis, and when the weapon is withdrawn, the elastic skin and dense fascial textures close or contract, so as to leave a very small orifice compared with the size of the weapon, or with the depth of the wound. If the muscular fibres have been divided, a large deep wound is left, because the muscular fibres retract and gape, while the skin and fascial textures contract.

This form of wound will be modified according to the form of the weapon; it varies according as the breadth of the instrument increases from the point, or, as the edge is sharp and the blade thin or blunt. The most typical example of a punctured wound is that caused by a rapier or small sword, where the edges become blunted as they go upwards from the point. In a wound inflicted by the thrust of a broadsword, or ordinary military regulation-sword, the external orifice does not close so much, because the blade is thin, the edge sharp some distance from the point, and the weapon has more breadth and extent of cutting edge than in the former case.

The special dangers attending punctured wounds are considerable. First, there is the confinement of blood and other fluids in the deeper part of the wound, owing to the contraction of the external orifice, and its small size compared with the deeper part. This may lead to serious consequences, especially if the wound be in an important part. Secondly, a peculiar diffuse or erysipelatous form of inflammation, followed by great tension, is very apt to supervene, especially when fasciæ and muscles are implicated. Another point, not often alluded to in surgical

works, is the softening of the punctured muscles. The muscles become inflamed and softened, and in such cases symptoms of pyæmia are apt to set in. The patient, perhaps, goes on very well for ten or fifteen days, but then rigors come on, the limb becomes tense and glazed but not red, the pulse becomes very quick, irritative fever is set up, and death follows, attended with all the symptoms of pyæmia. On examining the muscles in such cases, they are found to be softened and paler than usual: sometimes, however, they are of a dark brown colour and broken down in texture. This softening of the muscles takes place very often in simple flesh wounds, inflicted by a stab, or even in the slighter forms of gunshot wounds. In punctured wounds the danger of hæmorrhage —either venous or arterial—within the textures, or into cavities, is great; as in cases where the wound has penetrated any cavity, such as the abdomen, where the blood cannot pass readily outwards; or when important organs like the lungs are injured, where the internal hæmorrhage would be very serious. There is greater danger of interstitial hæmorrhage taking place in punctured than in any other form of wound, because the deeper muscular textures retract, and leave a space where bleeding may go on, while the superficial skin and fascial textures contract, so that the blood cannot escape, and at last the whole textures become infiltrated with blood, and so lead to very serious consequences, independently of the mere loss of blood. This is shown by the ecchymosis which takes place afterwards. We must, therefore, in all wounds of this kind, look to the appearance of the patient, the state of the pulse, and the colour of the skin, as these will give indications of any internal hæmorrhage taking place. The principal dangers, then, in punctured wounds are:—1. Confinement of blood or other discharges in the deep part of the wound, owing to the contraction of the external orifice. 2. Inflammation, especially of the fascial textures, followed by effusion under the fascia, and a peculiar form of erysipelatous inflammation. 3. Softening of the muscular textures, followed by irritative fever and pyæmia. 4. Hæmorrhage, either by simple loss of blood, as in internal hæmorrhage, or by infiltration of blood into the textures, leading to unhealthy suppuration.

The *Treatment* of punctured wounds used to be, at once to convert them into incised wounds, and accordingly all such wounds were freely dilated as soon as possible. The principle was good, but it was carried to an absurd extent. Thus, in punctured wounds of cavities, counter-openings were made, and even setons introduced through the cavity. As regards the oozing of blood, or internal hæmorrhage, this must be looked to very carefully, and must be met according to the special organ wounded. With reference to the principle of dilating these wounds at first, it is quite true that dilatation is a proper method of meeting some of the special risks in punctured wounds; but does this class of wounds always require such severe treatment? The punctured wounds inflicted by a trocar are not necessarily followed by any bad effects, and in many cases of punctured wounds we may avoid the necessity of dilatation, by having recourse to simpler remedies, such as keeping the part at rest, applying cold by ice-bags to the part from the first, and a moderate amount of compression, by a many-tailed

bandage, so as to keep the parts in contact. We may thus prevent any bad consequences from taking place, and arrest the effusion of blood very much, so that little of it escapes into the cavity of the wound, and there is also less tendency to the accumulation of discharges.

If this treatment be adopted, and the patient be kept on antiphlogistic regimen, with opiates to procure rest, a punctured wound will often heal as kindly as an incised one. It is not therefore necessary to dilate every punctured wound at first, but if any tension comes on, or pain with erysipelatous redness around the part, then we must dilate, and that freely; but only after using prophylactic means to favour union by the first intention. The skin and fascial textures are to be divided freely and to the same extent. Then divide the fascia transversely as well as longitudinally, so as to make a crucial incision in it; this will relieve all tension. So also partially-divided muscular fibres require to be divided thoroughly and completely, not merely by an incision parallel to the fibres, but by a transverse one also, so as to give free vent to any discharges from the deeper part of the wound. But to dilate thus freely in every case would be very severe treatment, and it is only in certain cases that it is necessary, though, until very recently, it was the recognised practice of French military surgeons to dilate all punctured wounds at first.

There is only one case in which we should have recourse to dilatation at first, and common sense would show the necessity for it —namely, when we see symptoms of interstitial hæmorrhage coming on, and the limb becoming rapidly swollen, then the wound should be freely dilated, so that the bleeding vessel may be secured.

In all cases of punctured wounds opium is useful, especially when they have been dilated, to allay the pain and irritation. The patient should be kept at rest, and have antiphlogistic diet; febrifuge medicines, such as antimony or aconite, should be given, to meet the febrile excitement. After a time, especially when there is much suppuration from a dilated wound, the diet must be more nourishing. The ordinary stimulating lotions may then be applied to the wound, such as solutions of chloride of soda, sulphate of zinc, or sulphate of copper and a many-tailed bandage should be applied, so as to give some degree of compression and support to the parts.

Contused and Lacerated Wounds.— All lacerated wounds are more or less contused, though some only to a very small extent. By a *contusion* is meant an injury inflicted by some blunt or obtuse weapon, without any breach of the integument. There may be merely rupture of some small blood-vessel, which pours out its blood into the cellular tissue, producing slight ecchymosis; or the force may be so great as to give rise to complete destruction of the deeper-seated soft textures, whilst the elastic skin resists the action, and even retains its vitality for some time afterwards; for example, a spent cannon-ball or the buffers of a railway waggon may strike a limb so as to reduce it to a pulp. The great vessels are torn and injured, and the limb all but dead, while there is no division of the skin. This is a bruise; so is a black eye; but they are very different degrees of the same injury. Contusion may be a very slight or a very serious complication. In all

cases of bruise there is more or less ecchymosis, depending on the blood passing into the loose cellular tissue. When the deeper-seated parts have been very much contused, the ecchymosis does not appear for some days after the injury has been received; thus, in fracture of the fibula, caused by a twist, there is, at first, pain and slight swelling of the limb, but no discoloration. The fracture is put up, and when the apparatus is removed, the skin is found to be mottled, and of a purplish and yellow colour. This arises simply from the discoloration coming towards the surface from the bruised parts underneath. It cannot show at first, as it is deep-seated.

It is important, in medical jurisprudence, to distinguish between a post-mortem injury and one inflicted during life. If a dead body be bruised with great force, can there be ecchymosis? It is quite possible that, from the rupture of some of the larger veins shortly after death, a little semi-fluid blood may be effused; but we do not have the incorporation of the blood with the cellular tissue that we have in ecchymosis caused during life. The blood effused after death may discolour the parts, but it does not become incorporated with them, and we can wash or scrape it off, which cannot be done in the other case, owing to the complete incorporation which exists between it and the cellular tissue.

The treatment of bruises, when slight, consists in the application of warm lotions, or opiate applications, or cold water continuously applied; but if the bruise be severe, cold may be dangerous to the vitality of the part. In the slighter bruises, when we wish to prevent the discoloration, the application of cold or evaporating lotions of acetate of lead, muriate of ammonia, or vinegar, to the surface is useful. A very popular remedy, but one which can never be beneficial, particularly in bruises connected with fracture, is the application of leeches to get rid of the bruised blood; but, as has been already mentioned, the effused blood becomes incorporated with the cellular tissue, and cannot therefore be drawn off by the leeches. In fractures attended with bruising, the leeches not only do no good, but do positive harm; they prevent the fracture from being put up at once, and the bites often create irritation. The blood which the leeches withdraw is healthy blood, which we do not want to get rid of. When inflammatory action sets in after a contusion, then the leeches may be of use, but not otherwise.

When we have a large effusion of blood, as from rupture of a large vein, we are likely to do much harm by making incisions into the part at first, because the blood is apt to decompose and give rise to unhealthy suppuration, and thus occasion great difficulty in healing the wound. We rather try to get rid of it by using evaporating lotions to promote absorption and to prevent further extravasation from taking place. In this way we often find large quantities of extravasated blood disappearing without the necessity of making any incisions. But if, after eight or ten days, there occur rigors and feverishness, followed by redness, tension, pain, and fluctuation in the part, then an incision should be made, because suppuration has probably commenced from the decomposition of the extravasated blood, which should therefore be got rid of at once. After making the incision, the cavity should be washed

out with Condy's fluid or carbolic acid lotion, and wadding soaked in boracic acid lotion applied. But the incision should not be made at first, especially when the bruise is on the scalp, as it is apt to prove very troublesome.

The *Lacerated* contused wound is one inflicted by some instrument or machinery which tears rather than cuts—where the parts are divided, but the edges are ragged and torn, and the textures only partially divided here and there and not equally, the least resisting textures yielding more readily than the more resisting. Thus, the muscles and vessels may be divided and torn by a force which the nerves and tendons resist, or by which they are merely partially torn and dragged out. The force may be so great as to make almost an incision from its dividing the textures so evenly; but the parts are not really divided so cleanly as they seem. In other cases, the force may be applied in such a way as to tear out textures without dividing them completely. There is always more or less ecchymosis surrounding the edges of the wound, with more or less twisting and tearing of the textures, and therefore there is great risk of sloughing taking place, and scarcely any chance of union by the first intention.

In the simpler forms of lacerated wounds we may have a wound closely approaching to the simple incised wound—as, when it is made with a very fine saw moved with great force. The wound in this case is practically an incised one. In other cases, the machinery inflicting the wound is of a tearing nature, and then the textures are much torn and not evenly divided. Sometimes heat is added to this, so that there is scorching as well as bruising. An example of this is seen in accidents caused by the heated cylinders used in paper-mills for smoothing the paper. The wounds resulting from these are much lacerated and bruised, and the parts are also more or less burned. Good examples of lacerated wounds are those caused by a machine used in paper-mills for tearing up the rags, and which is called by the workmen a "devil." In these wounds, the tearing or mincing of parts is very great.

In lacerated wounds there are the risks of tetanus and irritative fever, and there is no chance of union by the first intention. They are more or less complicated, and we cannot therefore expect them to unite well, though, in those lacerated wounds made forcibly by a fine saw, there may be a chance of union by the first intention, owing to the comparatively even way in which the parts have been divided. The nerve filaments are torn partially or completely, but not evenly divided, and therefore there is a greater chance of inflammation and irritation succeeding. The tendinous and fascial textures too, from being torn, are more apt to slough; their vitality—never very great—is injured by the nature of the wound, and considerable sloughing follows. The primary hæmorrhage in lacerated wounds may be trifling, or it may be very great. In a lacerated wound caused by twisting of the part, or where there is much contusion, the vessels are not likely to bleed much at the time, the internal coats of the vessels being turned in upon themselves, and by this torsion a mechanical barrier is formed to the flow of blood. We often see large vessels pulsating in lacerated wounds without any blood flowing from them, and this is due to the

amount and kind of the force causing the injury. But this obstruction of the vessels at the time is not favourable to the hæmostatic changes taking place: the coats of the vessels are injured, and there is a risk of secondary hæmorrhage occurring in a few days, from the sloughing which takes place consequent on the destruction of the vitality of the vascular coats. Primary hæmorrhage occurs either when the parts are so far evenly divided as with a saw, or when a vessel has been injured at a point higher up than the main injury, and then profuse bleeding may occur at the time; but in all cases, even though the primary hæmorrhage is not great, there is a risk of secondary hæmorrhage taking place from the sloughing which necessarily follows on the injury.

LECTURE XXV.

Treatment of Lacerated Wounds: by Heat and Moisture; by the Tepid Bath, etc.—Question of Amputation—Poisoned Wounds: from Dissection; from Dead Animal Matter—Malignant Pustule: from Rabid Animals; from Bites of Insects, or Snakes, etc.

In my present lecture I proceed to point out to you the *Treatment* of lacerated wounds.

From the nature of the injury we can very seldon expect these wounds to heal by the first intention. There are certain dangers attending them, such as sloughing, suppuration, and secondary hæmorrhage, all of which are unfavourable to this result. There is also the risk of tetanus supervening in consequence of the torn state of the nerves. These are apt to inflame and give rise to irritation along their course, and so to affect the nervous centres. There is always, in large lacerated wounds, a certainty of partial sloughing at least, and great suppuration from the injured textures, and a long time must therefore elapse before such wounds can heal. In a lacerated wound, say of the hand, which does not necessitate amputation, the best plan of treatment is to apply heat and moisture, either by placing the part in soft poultices when the injury is slight, or by dressing it frequently with lint soaked in warm water, either simple or slightly medicated with Condy's fluid. We thus endeavour to allay irritation and favour the suppurative process taking place in its healthiest form. Anodynes are given to procure rest, and antimony or aconite to allay the feverish state of the constitution.

I would specially direct attention to the advantages obtained by treating lacerated wounds and burns of the extremities by continuous immersion in the tepid bath. The avoidance of all meddling with the injured part, and of the agony of the patient caused by changing dressings, is thereby so completely obtained, that the method requires only to be fairly tried to show its advantages. In the case of burns these advantages are most conspicuous, for the constant moisture keeps the cicatricial tissue pliable, and motion of the parts can be effected gradually, whilst the limb is immersed in the bath. It consists in placing the limb in a tepid bath by means of a suitable trough (plate x. fig. 2). The limb floats partly in the water, and is partly suspended by slips of bandage, so as to prevent any pressure on it. The heat and moisture can by these means be continuously kept up, without disturbing the patient. The bath is fitted with a tap, by which the soiled water is allowed to run off, while fresh water is occasionally added.

On the Continent, especially in Holland and Germany, this is done by having tepid water constantly trickling into the bath, an equal quantity of cold being allowed to escape. A little of Condy's fluid may sometimes be added to the water with advantage, not only on account of its antiseptic properties, but because the alteration of colour which takes place serves as a good indication of the frequency with which the water should be changed, or carbolic or boracic acid may be used, largely diluted. After a little time, the part acquires a sodden appearance, but the irritation is much lessened, and the suppuration goes on more favourably, and with less irritative fever than usual. I have found this plan attended with great success in the treatment of severe lacerated wounds and in compound fractures of the forearm and hand. In some cases this treatment cannot be adopted, and in some it is not necessary; in these we substitute warm-water lint, covered with gutta-percha or fomentation cloths, as the best methods of applying heat and moisture.

In lacerated wounds of small joints, such as those of the thumb and fingers, the constant application of cold is found very useful, but this must be done with care, as the cold may further weaken or even destroy the already impaired vitality of the part. It is only in lacerated wounds where the injured joint forms the most important part, and the laceration is the least feature of the injury, that the use of cold water or ice-bags is advisable. The application of heat and moisture is safer and better when the injury is a simple laceration. If we see any fascial texture partially torn, it is best to clip it away at once, as it is sure to slough afterwards. Partially divided filaments of nerves should be completely divided, and the ends of the larger torn nerves should be cut across, taking away, of course, only the torn end of the nerve. These, if left, might serve as a source of irritation and lead to tetanus. But it is too late to do this after a few days, because by that time the mischief has been propagated to the nervous centres, and is then travelling thence to the circumference.

As regards the after-treatment of lacerated wounds, when the suppuration has been established and the parts have begun to granulate, the treatment is just the same as in any granulating sore. Contraction of the parts is favoured by giving a moderate amount of support to the integument by a many tailed-bandage of lint, which not only gives support but also serves as a means for local applications. The ordinary stimulating lotions, such as those containing chloride of soda, are to be used, but weak at first; afterwards, those of a more astringent and stimulating kind, such as the sulphate of zinc lotion, should be employed.

Another question arising in cases of lacerated wounds is that of amputation. If the textures be very much torn, and the great vessels much injured, or a joint opened; if, in fact, there be such a destruction of parts that we cannot save the whole limb, then we must amputate, but still try to save as much of it as possible. But do not try to save too much, or you will lose by it: the contraction during the healing of the wound will be so great as to leave a useless stump. This is most to be attended to in the hand, where sometimes—by trying to save the whole, or by removing only one or two fingers—the remaining portion is

left quite useless, from the contraction of the skin and other textures. By taking off more fingers, more skin is left to cover over the wound, and a much more useful result is obtained. Does mere loss of skin and fascial texture require amputation? This injury is most commonly seen in the hand and foot, where we sometimes have the whole skin stripped off and hanging like an inverted glove from the points of the fingers or toes. If the skin be lost on both aspects of the hand and wrist, we cannot expect the skin from the forearm to cover the whole hand without great contraction taking place, and here therefore we must amputate, simply on account of the loss of skin—even though the great vessels and nerves may be entire: besides, the risk to the patient's life in trying to save the limb is much greater than after amputation. Still, in many cases, nature performs some wonderful cures: occasionally the skin borrowed from above may cover over a large surface without any great contraction. In one case, I found the whole integuments of the penis and scrotum torn off by the bite of a horse, and left hanging loosely by a mere shred. The skin was drawn back into position, and an attempt made to save it; but very soon it sloughed, and the whole penis and the testicles were left bare: yet this wound healed perfectly, so much so that little or no trace of the injury was left. In the hand, however, there is very little chance of the skin healing over the denuded parts without great permanent contraction. In other respects, the general question of amputation must be decided according to the amount of destruction of parts, and the state of the great vessels and nerves.

The next division of this subject includes the various kinds of Poisoned Wounds.—The severer forms of this class of wounds are not often met with in this country, though the more trifling ones are common enough. These vary in character, according to the nature of the poison. They may arise from decomposing animal matter, and such are dissection wounds, and the malignant pustule met with occasionally in butchers, which arises from their working constantly amongst dead animal matter.

Wounds from punctures inflicted in the dissecting-room are not uncommon; but, at the same time, are seldom troublesome, unless some peculiar poison has existed in the dead body, such as that of glanders, or unless the patient's health has not been good. There is almost always something also in the state of the constitution of the recipient, which causes a simple dissection wound to take on an unhealthy action.

The best thing to do with a dissection wound is to suck the part well at the time, or enlarge the puncture or incision, so as to let it bleed more freely, and then wash it with warm water, and perhaps take a little opening medicine. If the wound becomes irritable, red, and painful at night, so as to cause want of sleep, and if the patient feels out of sorts, the wound should be enlarged a little, and should be touched with nitrate of silver, which, though a painful remedy, destroys the morbid irritability, and then the local and constitutional disturbance ceases. A little saline medicine, or a chalybeate, may also be taken internally. But, as before mentioned, it is only when the health is not good that ordinary dissection wounds give any trouble.

Punctures received in post-mortem examinations are very different —especially in puerperal cases—when, even though the person be in good health, much constitutional disturbance follows on the wound. There is rigor or chilliness, and a feeling of pain extending up the arm; red lines are seen running upwards along the course of the veins. These are the inflamed absorbents, and ultimately the venous system becomes affected: the glands in the axilla become tender and sometimes enlarged, and there is pain extending up to the shoulder, and, in the more severe cases, the rigors are repeated, with headache and a tendency to delirium. There is sleeplessness at night, arrested secretions, and other symptoms of irritative fever, with a peculiar feeling of depression, præcordial uneasiness, and a desire to yawn and sigh. In these cases the patient should be at once put to bed and heat applied to prevent rigors; the bowels should be cleared out by an active purgative, an opiate given to allay the irritability, and anodyne fomentations applied to the wound and along the arm. If the wound be tense or irritable, it should be at once freely enlarged, and the nitrate of silver applied to destroy its morbid irritability: then apply poultices, and, if possible, place the limb in a tepid bath as recommended for lacerated wounds. The use of aconite, to allay the irritability of the pulse, is not so safe in this as in other forms of wounds; because in such dissection wounds there is a peculiar risk of sudden and sometimes fatal syncope. If aconite be given, its effects should be watched very carefully. After anodynes and local antiphlogistic treatment, we require to use stimulants and nourishing diet. The sesqui-carbonate of ammonia is useful in this class of wounds. These wounds require much care, not only in the earlier stages, but also in the after treatment.

The malignant pustule of butchers is very troublesome, and even dangerous; but it gives rise to more localised symptoms. The pustule is first of a dark-brown colour and spreading: it is often attended with symptoms of typhoid fever. The pustule must be destroyed by a caustic, and then fomentations applied. The constitutional symptoms must be met, like ordinary typhoid symptoms, by active stimulation, and attention to the state of the bowels and skin.

Another form of poisoned wound met with is that resulting from the bite of a rabid animal, producing what is called Hydrophobia. The wound may be inflicted some time before the symptoms of hydrophobia appear; though the length of time that may elapse between the two is stated very differently, and is still an undecided question. The late Professor Dick, of the Edinburgh Veterinary College, held that there was no such disease as hydrophobia, and that, in all the cases he had seen, the symptoms were the result of excessive fear and apprehension, giving rise to extreme *hysteria*, and indirectly leading to fatal consequences. But most surgeons recognise it as a distinct disease, which, unfortunately, proves fatal in almost every case.

The wound caused by the bite may heal kindly, and give rise to no troublesome symptoms; but some weeks afterwards, the cicatrix is seen to be red and feels irritable, with pain extending up the limb, and a peculiar feeling of depression. There is headache and intolerance of light, but there is no dread of the sight of water at first, though, when

the patient tries to drink, it produces a tremor all over the body. There seems to be a sort of choking or contraction in the throat: but it is not merely swallowing that causes this, because a draught of cold air reaching the patient will produce the same tremor. These symptoms proceed until they become almost identical with tetanic convulsions. The saliva flows copiously from the mouth. Another symptom is a peculiar irritation of the diaphragm and pharynx; the latter is evidently excited, and, on examination after death, is found to be dry, red, and sub-acutely inflamed, and the mucous membrane has a glazed appearance. The patient has a constant desire to drink, though, at the same time, he is unable to swallow any fluid. He coughs with a peculiar dry, husky cough, which is not unlike a bark, and this gave rise to the notion that the patient barked like the dog which had bitten him. This cough is produced by the irritation of the larynx and pharynx. Afterwards, fever supervenes; the pulse becomes quick, and delirium sets in; the patient is very restless, can swallow nothing, and dies from exhaustion and irritation.

The only *Treatment* of hydrophobia is prophylactic. If there be any doubt whether the animal that inflicted the bite is rabid, then it is best to apply the actual cautery to the wound, however slight it may be, and afterwards wash it and the surrounding skin with some alkaline lotion, such as diluted liquor potassæ, or a solution of pearl-ash; or, when these are not at hand, a strong solution of soap and water, so as to get rid of all the poison. Cutting out the bitten part is not so good, as we cannot be sure of removing all the poisoned matter, some of which may still exist on the edges; and, besides, we cannot always cut out the wound when it is deep, whereas we can always cauterise the surface which has been in contact with the poison. As regards the after-treatment, opiates and various other remedies have been tried, and occasionally a cure is reported, but none of the remedies yet tried can be trusted to; the only remedy being the application of the actual cautery at the first.

Should the dog or other animal which inflicted the bite be destroyed? Not unless it is certainly rabid, and then it should be killed at once; but if this be doubtful, it should be kept apart, under surveillance, so that, if it show no further symptoms of madness, we can assure the patient that there is no danger of hydrophobia coming on.

Poisoned wounds from bites of insects and snakes.—These vary in intensity—from the bite of a scorpion or centipede to that inflicted by the cobra. In the former, there is not necessarily any great risk to the patient, unless his constitution be delicate. All the symptoms generally disappear under mild treatment, such as warm fomentations, anodynes, such as Battley's solution of opium, or a drop of medicinal hydrocyanic acid in water, applied locally after suction of the wound, or some slight internal stimulus; but if the earlier symptoms have been neglected in a person of weak constitution, fatal results may follow.

On the other hand, in a bite from a very venomous serpent—as the cobra—the treatment must be immediate and energetic, as the poison runs its course very rapidly, and soon proves fatal if efficient treatment be not adopted. There is chilliness and tremor, the pulse becomes low

and intermittent, there is a tendency to collapse, and death may occur within a few hours; hence the necessity for active treatment. The poison must be destroyed at once, to prevent it from getting into the system: the limb should be tied tightly above the bite, and the wound should be sucked, or a cupping-glass may be applied instead. There is no danger whatever in sucking a poisoned wound from snake-bite, provided there be no abrasion of the mucous membrane of the mouth or lips; but a wine-glass, exhausted of air by a bit of burning paper, makes efficient suction without risk. Then the actual or potential cautery should be applied freely, and the parts washed with some strong alkaline solution so as to remove all the poison. The constitutional remedies must be very powerful. Diffusible stimulants are to be given; and perhaps the best is a preparation of ammonia, called "Eau de Luce," which may be given in doses of a tea-spoonful, and at frequent intervals, along with brandy or other common stimulants to sustain the circulation, and prevent the direct sedative effect of the poison upon the heart.

When the wound is on the trunk, or when the limb has been bitten high up, after trying to arrest the circulation, the cupping-glass should be applied, so as to remove the poison by suction, and then the cautery applied, and diffusible stimulants promptly exhibited. Afterwards, opiates may be given to procure rest and allay irritation. If the patient escapes the first dangers, he very soon recovers, though sometimes secondary irritative fever follows and proves serious.

LECTURE XXVI.

Gunshot Wounds: their Special Characteristics—Circumstances which regulate the Extent of Destruction attending them—Their Frequent Deviations from a Straight Course—Wounds inflicted by Small Shot: by Wadding—Superficial Injuries.

Next in the catalogue of solutions of continuity comes the group of injuries which is embraced in the class of Gunshot Wounds. Under this head I shall discuss injuries inflicted by the discharge or bursting of firearms, or by the explosion of gunpowder. These injuries differ rather in degree than in kind from other wounds, and are generally complicated by the lodgment of balls, or fragments of other foreign bodies.

A gunshot wound when inflicted in the soft parts in some degree resembles a punctured wound, inasmuch as the superficial or external opening is less extensive than the deeper portions. The parts surrounding its course are not so much cut as contused, twisted, and torn; and all the peculiar unfavourable conditions attending punctured wounds are not only present, but much magnified; for the degree of force with which the bullet is projected is such as to sever the textures with far greater violence, and to impair their vitality to a much greater extent. So that, whilst in punctured wounds there may be a fair chance of union by the first intention, in gunshot wounds we can hardly expect any such result; for although there are a few exceptional cases on record of these injuries healing by the first intention, yet such a result is extremely rare.

A bullet wound may be recognised by the following characteristics: —The aperture of entrance is small, rounded, and depressed. It is less in diameter than the bullet which inflicted it, or the muzzle of the gun or pistol from which the bullet was discharged. The edges are depressed and forced in, and, if the ball has travelled any distance, they are not blackened; a considerable extent of ecchymosis, however, may surround the part. The aperture of exit has a different appearance; the edges are everted by the ball passing out; they are somewhat ragged and torn; and the opening is larger than the aperture of entrance, though not always larger than the bullet. The aperture of exit is more variable than that of entrance, and in a few instances has been found smaller, but this is difficult to account for. It may have occurred from the irregular shape of the missile, such as a slug, or from the bullet having been flattened or split.

If we examine the track of a bullet-wound, we see that the skin has been thrust in, and that the surface of the wound is of a dull greyish

colour, and, if recent, presents a smooth appearance. After a time the skin at the edges of the wound sloughs, so that the aperture of entrance becomes enlarged. Likewise the textures in the track of the wound slough, and also those at the aperture of exit, so that the whole tract becomes larger than it was at first. Entering with great force, the ball must affect the different textures in different degrees. Those textures lying in the immediate vicinity of the passing ball have their vitality completely destroyed, while those just beyond are more or less impaired. It may be laid down as a general rule that the vitality of the texture immediately in contact with the ball is almost if not altogether destroyed. If the gun has been fired close, the skin will probably be blackened with the powder, some grains of which may lodge in the skin; and sometimes the edges have a livid appearance at first.

The course which bullets take requires to be carefully attended to. A very slight object will deflect a ball from its course—such as a piece of cartilage or the angle of a rib—and so prevent the ball from going into the chest, but make it course round among the muscles, and pass out again. This gives rise to the appearance of the chest having been perforated by a ball, especially when the track of the bullet is not very plain.* In other cases, a ball may enter, pass out, re-enter, and finally lodge, so as to give the appearance of the part having been penetrated by two separate missiles. In such cases, we must attend carefully to the position of the limb at the time when the injury was received. In the case shown in this sketch (plate vii. fig. 2), a ball entered the back of the wrist, came out at the front of the forearm, re-entered the front of the arm, and then lodged under the skin, at the back of the upper arm. This injury looks at first as if it had been caused by two balls; but, on examination, it was found that the man was taking aim when he received the wound, and the course of the ball was then easily understood. Again, if the leg be bent when the injury is received, a charge may enter twice, and come out again twice, in the same manner, as occurred in a case lately under my care in the hospital.

In some cases the bullet may pass out by the aperture of entrance. In one case a bullet passed right round the neck, and all but dropped out again at the spot where it had entered. Sometimes two balls enter by the same opening; and care must be taken to remove both. In civil practice we must be more careful, on account of the varying nature of the charge, and because the principal part of it may be left in, while only a small portion is removed.

We must, therefore, in all gunshot wounds, remember how easily a ball is deflected from its course, and must also attend to the position of the part at the time the injury was received.

The constitutional effects of gunshot wounds vary. They may depend in great measure on some peculiar condition, but in many cases they are altogether absent. When present, the surface of the body becomes chilled, there are generally tremors, and a certain amount of shock; the body is covered with a cold sweat, and a feeling of faint-

* When the Duke of Edinburgh was fired at by an assassin at Sydney, the ball entered behind near the spinal column, and was extracted in front, near to the umbilicus, without having penetrated the thorax or abdomen.

ness comes on. There are many instances on record, however, in which men have received gunshot wounds in action without knowing it, their attention being first drawn to it by some one else; and in many other cases the only sensation is that of a hard blow.

We now proceed to consider more in detail *Gunshot wounds, such as are met with in civil practice, inflicted by small shot, or by the bursting of a gun, or by the entrance of wadding.*

If the gun be fired at a distance, the small shot may not give rise to any serious consequences, as, from the scattering of the shot, only a few pellets will lodge here and there, and only a slight shock will be felt. But if the charge of small shot be fired at all close to the body, or if it be enclosed in a cartridge, or tightly rammed down, the effects will be very serious, even more so sometimes than those resulting from a bullet wound. One form of cartridge—namely, the wire-cartridge—is particularly dangerous, as the wire is always more or less torn up, and the fine points of it are very apt to tear and lacerate the blood-vessels, giving rise to great hæmorrhage even from the smaller vessels, just as in lacerated wounds; and, therefore, there is a greater risk of primary hæmorrhage from wounds made with small shot than from bullet wounds. In bullet wounds, and in many small-shot wounds, the risk of primary hæmorrhage is not so great as that of secondary hæmorrhage. The bullet may strike the sheath of the vessels, but they yield before the force, so that there is no bleeding at the time; though the sloughing which takes place afterwards causes secondary hæmorrhage.

The characters of the small-shot wound will differ as the shot enters *en masse*, or more or less scattered. If it enter *en masse*, and if the gun be fired close to the body, the appearance of the external wound (plate vii. fig. 3), is like the aperture of entrance in a bullet wound; there is the same small rounded opening, but when we come to examine more closely, we can easily distinguish between a small-shot and bullet wound. In the former the edges are cut round, as it were, and somewhat ragged—not depressed as in the bullet wound—and always when the shot is fired very close, the powder is engrained into the cellular tissue about the wound, giving it a dark-greyish or blackened appearance. The aperture of exit is very different. As a general rule it is very much larger than the aperture of entrance. In a case of gunshot wound of the abdomen recently in hospital, under my care, in which the charge lodged in the abdominal cavity, the aperture of exit in the abdominal parietes was smaller than the aperture of entrance. It is difficult to explain this; unless it was due to the elasticity of the parts. The textures are usually much torn up, giving the aperture of exit a very ragged appearance (plate vii. fig. 3), when compared with the aperture of exit in bullet wounds. If such a wound pass somewhat obliquely through the soft parts, it has in many cases a slit-like appearance. Even though the shot enter *en masse*, there is always more or less scattering of the shot along the track of the wound, tearing up the fascial and muscular textures, and if a bone be struck it is shattered completely; there is therefore great suppuration and sloughing, as in lacerated wounds. In some cases the

shot may pass out again *en masse*, when enclosed in a cartridge, and the effect will be like that of a ball: there will, however, be more destruction of parts, and contusion of the textures, and, consequently, a greater absolute loss of vitality. In some cases the shot strikes obliquely, and tears the surface, thrusting aside the superficial parts rather than entering. It is important to remember in lacerated wounds, and in this form of gunshot wounds, that when much muscular texture is torn away or sloughs afterwards, the wound will heal by contraction, and leave a tolerably useful limb, provided much skin be not lost; but if a large amount of skin is torn off, and little muscular texture, the wound will not heal readily, as the contraction would be very great, and a comparatively useless limb would be left.

Another form of gunshot wound met with in civil practice is that inflicted by paper wadding only; it also occurs in military practice, occasionally, with blank cartridge. In many cases the wound very closely resembles that caused by a bullet, and the track it makes is very much the same. From the loss of vitality of the parts, and consequent sloughing and irritation, it is a very troublesome, and sometimes a dangerous, form of wound. The great point is to examine the wound early, when we can distinguish the wadding from the other textures; if left in for a short time it becomes so softened, and soaked with blood and other discharges, that it is very difficult to distinguish it from the soft tissues. A careful examination must therefore be made as soon as possible, and all the paper removed.

As regards the progress of gunshot wounds in the soft parts, all these wounds have a tendency to suppurate and slough to a certain extent, and to heal by secondary intention or granulation—not by the first intention. Instances have occurred of gunshot wounds healing by the first intention, but these are the exceptions to the general rule. The very nature of the wound prevents it; the dead portions must be first got rid of by suppuration and sloughing. In most cases the track of the wound becomes inflamed, red, and swollen; the edges of the apertures become everted, and suppuration soon commences; the slough separates, and then the aperture changes in character, the orifice enlarges according to the extent of the loss of vitality of the soft textures. In many cases of small-shot wounds, from the very nature of the wound, the discharges take place freely; parts of the torn fascial textures are got rid of at once, and often suppuration, rather than much sloughing, takes place. In some cases a large wound will heal very quickly, with little or no constitutional disturbance, but generally it is very different, even though the wound may not seem very serious, and where no hæmorrhage of any consequence takes place.

In some cases the patient may go on well for some days, then rigors set in, the tongue gets foul, and other symptoms of febrile excitement arise. The limb becomes swollen and has a glistening appearance; this condition occurs in small-shot as well as in bullet wounds. Mr. Guthrie, who described this symptom, attributed it to phlebitis. In cases of stabs, also, as already mentioned, the muscles are found to be softened and broken down in texture. This arises from an unhealthy form of inflammation being set up in the muscular textures, and leading

to symptoms of pyæmia and secondary abscesses. I have seen a fatal result follow from this cause in what seemed a very trivial case of wound by small shot. Only a few pellets had struck the leg, and most of them were lodged superficially. The symptoms described above came on three weeks after injury. On examination of the wounded limb after death, two or three No. 4 shot were found to have penetrated the substance of the gastrocnemus, and its fibres were softened and studded with little points of suppuration.

In those cases where the shot strikes the surface rather than enters *en masse*, the wound goes on more favourably; the degree of force is not so great, and the skin is thrust aside rather than injured; and though sloughing of the deeper textures takes place, there is plenty of skin left to cover in the wound, and the results are generally favourable. In some cases, however, of gunshot wounds, whether inflicted by small shot or ball, there is a risk of secondary hæmorrhage. Primary hæmorrhage is not so common in bullet wounds as in those from small shot, especially if the shot be enclosed in a cartridge. A ball entering the thigh may not cut across the femoral artery, it may strike the sheath of the vessel and impair its vitality, and so lead to unhealthy suppuration —the coat of the artery sloughs, giving rise to secondary hæmorrhage ; or the same may take place with the femoral vein. In cases of secondary hæmorrhage, when the bleeding vessel is secured, we must watch how the collateral circulation is carried on. In one of my cases the brachial artery was exposed, and apparently intact, though one of the veins was injured, and the ulnar nerve and inferior profunda artery divided. The limb became swollen, and about a week after the injury was received bleeding took place from the main artery, which was at once arrested by a ligature (*see Clinical Cases*, Case V.) In this case the circulation went on quite well by the remaining collateral branches, and the man made a good recovery with little loss of power in the arm.

As regards lesion of nerves—If a nerve be torn or partially divided, it should be completely divided, just as in lacerated wounds. If it be completely torn across, the torn end should be cut evenly across, so as to prevent nervous irritation, which might give rise to tetanus; partially-divided large nerves, such as the sciatic or median, should not be cut across; opiates are to be given to relieve the pain and constitutional irritation. (*See Clinical Cases,* p. 197.)

LECTURE XXVII.

Wounds inflicted by the Bursting of Firearms—Their Character and Treatment—General Treatment of Gunshot Wounds—Risks of Secondary Hæmorrhage—Prognosis.

Before entering on the subject of the general treatment of gunshot wounds, I have a few observations to make regarding injuries inflicted by shot entering through a small aperture and then expanding, or by the bursting of firearms.

In many of these cases there can be no doubt as to the propriety of amputation; and here the danger is rather in an inverse ratio to the size of the external wound, the danger being also greater if there is no aperture of exit. In the case of a gentleman under my care there was only a small opening in the palm of the hand, without any aperture of exit, moreover, there was no great destruction of the bones, merely some injury at the articulation of the carpus and metacarpus, but the shot had expanded laterally, tearing up the nerves, tendons, and blood-vessels in the palm, and so necessitated amputation (*see Clinical Cases*, Case VII.) In all cases of gunshot wounds we must consider the degree and kind of force causing the injury, when estimating the danger of the wound and its effects, and considering the question of amputation.

Wounds from the bursting of firearms are met with very frequently in the hand and wrist, and here they often render amputation necessary. But we are not to assume that there is anything peculiar in the nature of the injury itself which necessitates amputation; it is required simply on account of the nature of the parts injured; the joints being opened into, or the great vessels destroyed. In many cases, however, the bursting of a firearm or the explosion of a powder-flask does not cause so much real injury as some other forms of wounds. It depends in a great measure on the part of the gun which inflicts the wound. If the breech be driven out and strike a person, then a very formidable injury is the result; the heavy mass of metal projected with great force producing all the worst effects of a ball wound. If, however, a portion of thinner metal of the barrel strike, it cuts the parts rather than tears or contuses them; and, when projected with great force, sometimes cuts as evenly as in an incised wound. And when in such cases amputation is requisite, the cut so made may form part of the line of incision for the operation—as in this thumb (plate ix. fig. 5), where the lines of the incision were made by the fragments of the gun-barrel (*see Clinical Cases*, Case XII.) The sharp edge of the metal cuts the

skin evenly, though the muscular textures are, of course, torn and twisted to a certain extent. Some wounds of this kind look much more formidable than they really are, while in contused and lacerated wounds we cannot always calculate the amount of danger, because the injuries often look less serious than they really are.

A wound caused by the bursting of a gun usually at first looks very serious: the parts all blackened; the muscles and tendons apparently torn; perhaps some of the bones broken; the smaller joints of the fingers opened into, and the parts so far lacerated. Yet, when we wash away, as far as possible, the gunpowder, and remove any wadding that may have entered, the textures, and especially the skin, are found to be more cut than twisted or contused. Their vitality is therefore less affected, and often, by merely removing a part, we can save a very useful hand, though at first the injury may have appeared to require amputation of the whole. If the wound opens into the wrist-joint, and divides tendons, vessels, and nerves, complete amputation of the hand will be necessary. In other cases, the laceration caused by the bursting of a gun is so great as completely to shatter the arm, and then amputation must be performed higher up. When a shell bursts, the amount of force with which it strikes is very much greater, and, as a general rule, requires amputation; but even in these cases, a portion of a shell striking obliquely—if it does not fracture bones or injure any of the great vessels—will not inflict so much injury as a cannon ball.

There is in this form of gunshot wound—as in incised and lacerated wounds—a great risk of hæmorrhage. The sharp edge of the thin metal of a gun-barrel will divide the vessels it comes in contact with, and cause primary hæmorrhage, though it may occasionally pass close to large vessels without injuring them; but if it strikes them they will be cut.

We shall now consider the *Treatment of Gunshot Wounds.* The treatment of a flesh bullet-wound is very simple. The first point to be attended to is to ascertain whether the ball has passed out or not. If it has lodged, we must ascertain its position, and then extract it by enlarging the wound when necessary. If the ball has passed nearly across the limb, and has lodged near the opposite side from where it entered, it is best to make a counter-opening, and cut down upon the ball, and thus complete the track of the wound, so as to allow discharge and sloughs to escape readily. If the ball lies deeply, or has passed about half-way across the limb, then the aperture of entrance should be enlarged, and the ball extracted with the bullet-forceps, without making any counter-opening. Some surgeons recommend that when the ball is deeply seated, or where it has lodged near important organs, it should be left alone, and not interfered with. This is not good practice, unless it so happen that we cannot reach the ball without endangering some of the great vessels of the part; but even then the practice is questionable, on account of the very fact that the ball by lying near great vessels will injuriously affect these vessels from the sloughing and suppuration which will be set up; and, therefore, in all cases where it is practicable, the ball should be extracted at once. For example, in the case of a ball entering the thigh and lodging close to the course of

the femoral vessels, the opening should be enlarged and the ball extracted. The presence of the ball, if left in, would be very apt to give rise to irritation and inflammation of the parts, and so cause a great risk of secondary hæmorrhage. If there be a risk of bleeding, it is better to meet it at once than afterwards, under less favourable circumstances. There is scarcely a case in which a ball should not be extracted if possible; but more especially is it necessary to extract any wadding or portion of dress which may have entered, as these would give rise to great irritation, and from becoming softened in the discharge, would not after a time be easily recognised.

The first thing to be done in a flesh bullet-wound, therefore, is to ascertain the position of the ball, and then extract it, either by enlarging the aperture of entrance, or by making a counter-opening if the ball has lodged near the opposite side of the limb. Of course, if the ball has entered a cavity, such as the chest or abdomen, we could not attempt to extract it from among the viscera. In such cases we cannot interfere. There is another reason for extracting a ball when possible—namely, that the patient's mind never feels quite at ease when the ball is left, and a good deal of mental irritation is kept up. In flesh wounds inflicted by small shot, it is necessary to remove all wadding and pellets; and it is often advisable to make a counter-opening, so as to let the wound be washed out freely, and the track kept clear. But here we need not try to get rid of every stray pellet, because from the scattering of the shot it is impossible to tell where they have all gone to; and besides, if left, they remain quiescent, and do not cause much irritation afterwards. If fired near the body, the pellets sometimes take very peculiar directions, and cannot be found easily. In a wound of the hip which I attended, some pellets passed out per urethram from the bladder without any bad effects. Certainly, with much less mischief than would have happened had an attempt been made to extract them had their position been known.

The treatment of gunshot wounds, after the extraction of the foreign bodies, is very simple. The surface and track of the wound may be moistened with very dilute carbolic acid or other antiseptic. Then apply cold or tepid-water dressings, lint dipped in carbolic oil, on the surface and along the track of the wound, washing out the wound occasionally if there be a counter-opening. These local measures, with the use of antiphlogistic diet and medicines, along with opiates to allay irritation, are the chief points in the treatment. When inflammation is set up, with redness extending from the wound, and some swelling along the margins, then we apply warm-water dressings. When there is much tension dilate freely; and if there be much sloughing use charcoal dressing, or some Condy's lotion, to get rid of the fœtor. In gunshot injuries of the forearm and leg, the tepid bath, as in lacerated wounds, answers admirably. When the sloughs are separating, and granulations beginning to appear, the patient's strength must be supported. The diet should be more nourishing and stimulating than before. The limb may then be supported by a bandage from below upwards, and the solution of chlorinated soda, or other stimulating lotions, applied to the wound.

The question of amputation, either primary or secondary, often arises in gunshot injuries of the soft parts from the extent of destruction of tissues. Where a considerable amount of the deep textures is destroyed, or carried away, whilst the skin is not much injured, nor the great vessels or nerves divided, the wound will heal up readily, just as in lacerated wounds of a similar description, and therefore amputation is not required.

Secondary hæmorrhage frequently follows after wounds from bullets and from small shot. If a large vessel have given way, we must enlarge the wound and tie the vessel at a little distance above and below the bleeding point. We may use the ordinary ligature, or acupressure. The rest of the vessel is healthy, and the collateral circulation is likely to be sufficient for nutrition. Where the circulation is not re-established, then amputation is, of course, necessary. Secondary hæmorrhage occasionally takes place in another form in flesh wounds. It is described by Mr. Guthrie, but is not common. It consists in a persistent oozing from the surface of the wound, and depends apparently on constitutional causes entirely. It is generally preceded by great febrile excitement. The parts acquire a glazed and swollen appearance, and from part of the injured surface smart oozing takes place, which may be temporarily arrested, but occurs again and again till the patient is exhausted. The bleeding does not come from any particular vessel. It may even occur when the patient is convalescent. Mr. Guthrie attributed it to the state of the patient. It occurred in several cases in the Peninsular war, but it is not a common form of hæmorrhage, and I have never seen it occur after gunshot wounds, though I have seen a form of hæmorrhage like it after operations for malignant disease —a grumous bloody discharge going on incessantly from the whole surface of the wound.

As regards the prognosis of bullet flesh wounds: If no bone be broken, if no great vessel be injured, and if the ball be extracted immediately, the result will most likely be favourable; fatal consequences, however, may follow from the softening of the muscular texture, and from pyæmia and phlebitis setting in. The prognosis in the case of small-shot flesh wounds is not so favourable, as the amount of injury is difficult to estimate. In one case the injury appeared very trifling, and the surgeon tried to save the hand, but in a few days inflammation set in, with great swelling of the limb, and the patient was placed under my care. I then made incisions in different parts of the limb to allow of the escape of the discharges, and removed all the wadding; the limb was placed in a tepid bath, and the other treatment carefully attended to; but, notwithstanding, secondary amputation was required, and this had to be performed in the upper arm, and under much less favourable circumstances than if partial amputation of the hand had been performed at once. In this case some of the metacarpal bones were injured, having the periosteum stripped off, and this formed an important feature in the injury. In another case under my care the injury looked much more formidable; the man had received the shot from both barrels of a gun in the forearm, where the charges had lodged; the whole limb, when he came into the hospital, was tense, painful, and

erysipelatous, and the pulse could not be felt; but the patient was not in a state for amputation being performed. Here I enlarged the opening of entrance, and removed all the wadding and pellets within reach, together with portions of torn muscles, and also made a counter-opening. Charcoal poultices and warm-water dressings were then applied; the sloughs separated, some more pellets came away, then the wound granulated and healed perfectly, the irritative fever ceased under local and constitutional treatment, and this man was able to take part in rowing and working at the herring-fishing three or four months afterwards. These two cases, when contrasted, will show how difficult it is to estimate the amount of injury inflicted by small shot; the one case required amputation, though it did not at first appear to be such a serious injury as the other—probably owing to the metacarpal bones being injured and the confined nature of the wound. In another case lately in hospital, a boy received a small-shot wound in the axilla, which looked comparatively trifling, but the subscapular muscle was torn up and the surface of the scapula laid bare to a small extent. The case went on well for some time; but ultimately the patient died from pyæmia and secondary abscess, resulting, I believe, from the injury to the bone (*see Clinical Cases*, Case IV.) In another case of a young gentleman under my care some years ago, for a small-shot wound of the hip, the greater part of the glutei muscles were torn away, the sciatic notch and nerve exposed, and the gluteal artery wounded, but no bone was laid bare; and this patient made a good recovery, the wound healing with very little scar by the contraction of the skin which had been thrust aside. It is always therefore, I believe, an unfavourable condition when bone is laid bare, as this increases the danger. The two cases related, which recovered, looked much more formidable than the other two, but in neither of them was any bone injured; while, in the case which required secondary amputation, the metacarpal bones were deprived of their periosteum, and in the fatal wound in the axilla a portion of the scapula was denuded.

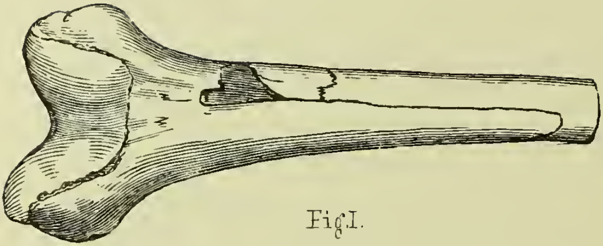

Fig.I.

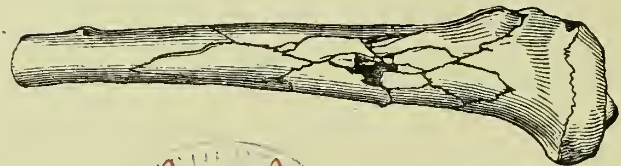

Fig.2.

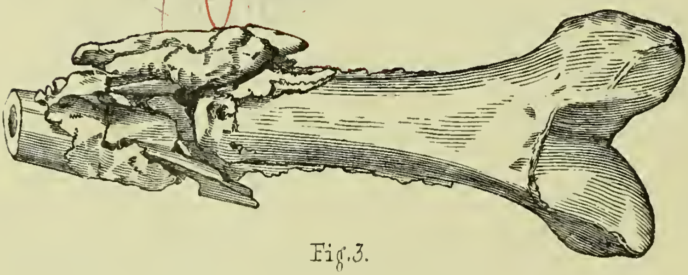

Fig.3.

Fig.4

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LECTURE XXVIII.

Gunshot Injuries of Bones and Joints—Special Risks attending on Injuries of Joints—Different methods of Treatment—Excision *v.* Amputation—General Rules for Amputation when necessary.

By this time you will have learned that the injuries of which we have been speaking are very much modified or aggravated, not only by the nature, force, and direction of the missile employed, but also by the quality of the texture against which it strikes. And nowhere do we find this better exemplified than in connection with

Gunshot Injuries of Bones and Joints.—When a ball strikes the dense part of a bone it produces very different and much more destructive results than when the softer or cancellated texture is struck. A ball striking the dense shaft of a bone breaks it into pieces (plate viii. figs. 2, 3, and 4); but it does not break up the cancellated texture in the same way—it sinks into it, on account of the texture offering less resistance (plate ix. figs. 1, 2, 3, and 4). When a ball strikes along the surface of a bone like the ilium, it forms a deep rut in it; but when the ball strikes the shaft of a bone, it shatters the whole bone, not merely where it strikes, but the whole bone is broken up, fissures extending both longitudinally and transversely (plate viii. fig. 1). When a bullet passes through the softer part of a bone like the tibia, it may form a rut in it, and leave a rounded opening like that made by a bullet in a flesh wound. When a somewhat spent ball strikes a bone, it leaves an aperture of entrance with the edges depressed; but the aperture of exit is different—there the bone is broken up by the force of the passing ball.

The effects produced are—that the vitality of the bone is completely destroyed, blood is effused into the Haversian canals, and an unfavourable form of inflammation extends throughout the bone, causing acute necrosis or death of portions of the bone. When the shaft is struck the worst effects of comminuted fracture are produced; the dense texture has its vitality at once and completely destroyed, and the form of the fracture gives rise to longitudinal fissures, which are very unusual in other fractures; complete comminution and separation of different parts of the bone take place, and the periosteum is also separated from the bone, the vitality of the internal Haversian structure being also destroyed. Such an injury is therefore the most intense which can be inflicted upon a bone, and the harder the bone the more

serious will be the effects produced. In the cancellated texture of bone the ball may pass through and leave a rounded opening, without causing any direct or immediate injury to the parts around, though, sooner or later, it does give rise to this. We sometimes find in the bones of animals, and especially in textures closely resembling bone, such as the tusks of different animals, that a ball has lodged and become encysted, as it is called, and it may lie there for years without producing any bad effects. So in man also, when a bullet strikes the cancellated texture of a bone, it may lodge in it and remain for a long time without doing any harm, and this sometimes happens. Amputation of a limb, however, may be required many months after the receipt of an injury of this kind, owing to the bone becoming affected with a form of caries.

In the upper extremity we may often attempt to save the limb after a gunshot injury, when we could not do so in the lower extremity. Formerly it was laid down as a rule, that in gunshot injuries of the femur amputation was always required ; but there are cases where, under favourable circumstances, we may be warranted in trying to save the limb. When the shaft of the femur or tibia is extensively broken up, then primary amputation is the safest treatment, because, even under the most favourable circumstances, when the patient does not require to be moved, and when every appliance is at hand, the process of healing is very prolonged and often ultimately fails. Moreover, the limb which is saved is deformed and shortened, and the patient is subject to a very great risk from the suppuration, and from abscesses forming in the soft parts around the bone ; moreover, the chances of pyæmia supervening are very great. As a general rule, gunshot fractures of the femur and tibia are cases where amputation is necessary.

When the bone is hit by small shot striking *en masse*, the amount of injury caused is still greater ; the bone is broken up into fragments, the periosteum is stripped off, and the surrounding textures much torn up. In these cases, therefore, amputation is even more necessary than when the bone is injured by a ball. In the upper extremity we may run some risk for the chance of saving the limb ; for even, though the humerus be deformed after saving the limb, if the forearm and hand be left uninjured, the result is a sufficient reward for the risk. Besides, the vitality of the textures in the upper extremity is greater than in the inferior extremities, being nearer the centre of circulation. The treatment also is easier, as the arm can be slung. And in military practice, a patient with a fractured humerus can be moved about much more easily than one whose femur is broken. So that, for these reasons, the arm can often be saved when the leg cannot.

When a ball strikes the cancellated texture of a bone it produces different results. It generally makes a rut through the surface of the bone, and passes out again—just as in the softer textures—by a circular opening, without shattering or comminuting the bone, unless the ball strikes with great force. In the bones of the cranium the ball sometimes passes out, making merely a small circular opening, though generally the inner table is extensively broken up ; and in such cases trepanning must be performed. When the ball strikes the cancellated

Plate IX

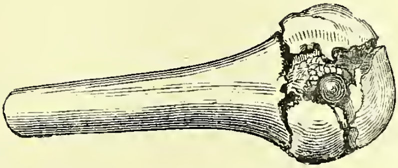

Fig. I.

Fig. 5.

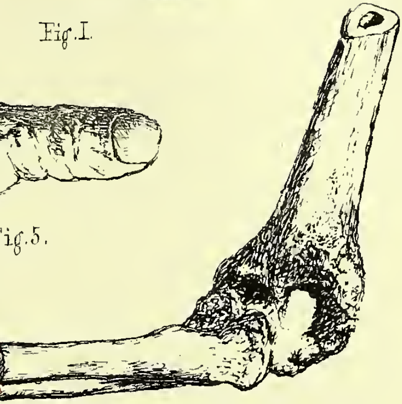

Fig. 2.

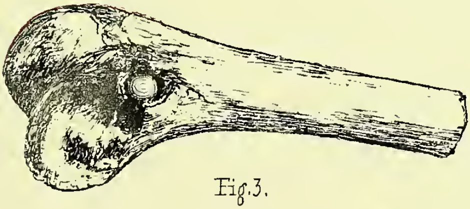

Fig. 3.

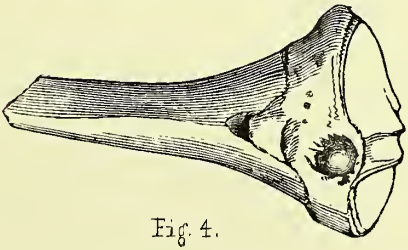

Fig. 4.

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texture of a bone in the neighbourhood of a joint, it may—according to the size of the ball and the particular bone struck—either rest in the cancellated texture of the condyloid end of the bone without entering into the joint, or it may break up, or else lodge in the joint. Near the knee-joint—especially in the large condyloid extremity of the femur—the ball may enter at the side without opening the synovial sac, and lodge in the large amount of cancellated texture there (plate ix. fig. 3), and it may remain there for many years, sometimes without producing any bad effects, beyond causing stiffness of the joint and the risk of exciting disease. The secondary effects of gunshot injuries of bone must, however, always be taken into account, as they may give rise to a disease analogous to caries, and necessitate amputation long after the receipt of the injury (plate ix. fig. 2). Sooner or later such injuries lead to suppuration, and give much distress to the patient, and ultimately may necessitate operations, which would have been much better done at first. If the ball has entered the joint, or broken up the bone into the joint, or if it lie very close to the articular texture, so as to project the articular surface of the bone before it, then the injury is a very dangerous one.

At one time, all injuries of joints—whether inflicted by a ball or by small shot—were considered as cases for amputation. All wounds of joints are dangerous, and gunshot wounds are especially so, from the foreign body being generally lodged in the joint. Hence, the general experience of military surgeons, up to A.D. 1800, was, that in gunshot injuries of joints in the lower extremity, and even in the upper extremity, amputation was as a rule necessary. But it is an operation which should be avoided if possible, provided that, at the same time, the source of irritation can be got rid of, and a tolerably useful limb left. Afterwards, some surgeons adopted the expectant plan of treatment, which consisted in applying hot or cold applications to the limb, and keeping it at rest, so as to procure anchylosis. In 1830 many cases of these injuries occurred in Paris, and were carefully investigated by the late Baron Dupuytren. He pointed out that, in the upper extremity, and even in the lower extremity, in hospital practice, where all proper appliances can be readily obtained, many limbs might be saved by extracting the ball, and allowing the joint to anchylose, though, of course, the joint would be quite stiff, and the healing process would take a long time. If the great vessels of the limb have been injured, then amputation would be required. The same had been pointed out by Hennen and other military surgeons, who showed that in certain cases wounds of joints did get better, and surgeons therefore became more careful about amputating in all cases. But when we come to look at the results of their experience, we are led to the conclusion that perhaps amputation might have proved better treatment, from the number of lives lost in attempting to save limbs, and from the comparatively useless limbs left.

During the war in Algeria, and that in Schleswig-Holstein in 1848, the plan of treatment was first generally adopted which had been often proposed but never carried into effect—namely, PRIMARY EXCISION of the wounded joint. In all cases of injuries of joints caused by bullets, where the soft parts are merely traversed by the ball, and where the

joint is directly or indirectly injured by the ball passing through or near it, this is the best operation that can be performed. It is a conservative operation, and is not attended with the same risks as is amputation or the expectant treatment. If neither amputation nor excision be performed, secondary disease is likely to follow—a peculiar chronic affection of the bone takes place, abscesses form about the joint, and the patient's health gives way, even though anchylosis may have occurred. Such cases show the risk run in trying to save the limb. If excision of the joint be performed as soon after the injury is received as possible, the limb is saved, the source of irritation leading to secondary disease is got rid of, there is less chance of bad consequences, and a much more useful limb is left than if amputation had been performed or a cure by anchylosis obtained: the results of primary excision in such cases are much more favourable than those of amputation or any other method of treatment. In ordinary surgical practice we often perform excision of joints secondarily, for the effects of fractures or other injuries leading to stiffness of the joint from anchylosis. The results given by Professor Langenbeck of Berlin, M. Baudens in Algeria, and Eschmarck of Kiel, are very favourable: Out of 11 primary excisions of the shoulder-joint 10 recovered, and only 1 died. Out of 15 cases submitted to expectant treatment, because less severely wounded, 8 died from exhausting suppuration, 4 left with fistulous openings, and 3 were cured by secondary excisions. Out of 40 resections of the elbow only 6 died, 1 required secondary amputation for gangrene of the forearm. Of the rest, some were anchylosed, which result is attributed —justly, I think—to the operation being performed secondarily. To give the operation a fair chance it should be performed as soon after the receipt of the injury as possible; because inflammation and suppuration soon set in, and the operation has then to be performed under great disadvantages. In injuries of joints caused by small shot, excision is unsuitable, because the shot expands after entering, breaks up the bone into fragments, and tears all the surrounding soft parts. These injuries are therefore not to be considered in the same category as the former, where there is simply the track of the ball, which may be converted into part of the incision.

Indeed a method of treating gunshot wounds of the soft parts has been tried in America during the late war—namely, to convert them into incised wounds—and the results in some cases have been favourable, and in excision of the joint, this is what we do as regards the soft parts wounded. In small-shot wounds amputation is necessary as a rule, though there are exceptional cases on record in which the joint was greatly injured and yet the limb saved (*see Clinical Cases*, Case VIII.) In the lower extremity, the treatment of gunshot wounds of the hip, knee, and ankle, presents points of difference from that of injuries of the arm. In civil practice, or in cases where there is an hospital at hand, and in military practice, when an army is in position, we may attempt primary excision of the knee or ankle; but when we require to transport the wounded a considerable distance, and when the patient is subjected to unfavourable conditions, excision cannot be expected to prove so successful. In the

upper extremity, amputation should not be performed till excision has been tried; if the bone be found shattered into the shaft, then amputation must be performed. When the ball is lodged in a bone near the surface we proceed on the same principle as in bullet-wounds of the soft parts. We cut down upon the joint on the outside, so as to avoid opening the joint, which the ball may not have done, and then, with a gouge or pair of sharp-edged bullet-forceps, extract the ball from the bone, or with a trepan take off part of the bone covering the ball; we can thus extract the ball from the cancellated texture as easily as from the soft parts. We thus get rid of the foreign body, and prevent bad consequences following, such as abscesses and secondary disease; and it is perhaps better to gouge away some of the cancellated texture in which the ball was lying. In the upper extremity, however, I would much prefer excision to any attempt to extract the ball, because the ball can hardly have struck the head or condyles of the humerus or the upper part of the ulna without implicating the shoulder or elbow joints more or less directly.

In most cases of injuries to bones and joints from shot, cannon-balls, and shells, the limb is either completely or all but torn from the trunk; in such cases therefore, or where a spent ball has struck a limb and reduced it to a pulp, there can be no doubt as to the propriety of amputation. If the injury be on the trunk the patient is generally beyond relief. When the bullet or piece of shell strikes obliquely, it may not do much more harm than the bursting of a gun-barrel, but this is a rare occurrence, and when it happens, the case is to be treated in the ordinary way. When a round shot strikes a limb, even when it is spent, the amount of force is such that though the bone does not appear to be much injured, if the soft parts are, then it is a case for amputation. In gunshot wounds of the cranial bones, when the ball partially or completely perforates the bones of the cranium, trepanning is necessary; if the ball has not passed out, we can feel it, and it should be extracted during the operation. Even when the ball passes between the bone and the scalp, the result is almost always unfavourable; great effusion of blood takes place between the bone and the dura mater, and the loss of vitality of the bone itself is so great as to lead to necrosis afterwards, and on examination the bone is found to be full of small fissures. In one case of a man under my care, the injury looked as if it had been inflicted by the butt-end of a gun, but the edges were blackened and a few pellets had lodged. The man was suffering from symptoms of compression; the bone was quite comminuted, but no hole was to be seen. As soon, however, as one fragment was taken out the rest became quite loose; the dura mater was not visibly injured, but in three or four days it lost its natural appearance, and that part of it, corresponding to the injury of the bone, sloughed.

As regards the general rules for amputation in gunshot injuries: These are very much the same as in railway injuries and other severe lacerated and contused wounds. One point of difference to be attended to, however, is that it may be necessitated by what may appear a slight injury, implicating only one or two important textures, as, for example, the femoral artery or vein may be injured without any of the other

important parts in the neighbourhood, and then primary amputation is necessary, as the amount of subsequent swelling interferes with the collateral circulation, and a sort of low traumatic gangrene takes place. In the upper extremity, in a similar case, I would not have recourse to amputation. If secondary hæmorrhage does take place, by tying the injured artery, and watching to see that the collateral circulation is carried on properly, we can often save the limb; but when the femoral artery or vein is injured there is not the same chance of saving the limb, and therefore amputation is required. When the great sciatic nerve is injured, primary amputation is generally considered necessary, because the whole innervation of the leg, at least below the knee, is impaired; but still this is not so urgent a case as when the femoral vessels are injured, and I would rather wait a little to see whether innervation might be carried on from other sources. In such cases, when gangrene sets in, it is of a subacute or chronic character. When the femur or tibia, or even the humerus, is comminuted to a great extent, and when there is much bruising of the soft parts along with such an injury—Amputate. Shell or a round shot striking a limb necessitates amputation generally. These general rules, however, must be judged of in connection with the circumstances of each case. Even in contused wounds there is often great danger from trying to save the limb, and in gunshot wounds this danger is still greater. Hence, as before mentioned, we must always keep in mind the amount, as well as the kind of force which caused the injury, and the circumstances in which the patient is placed as regards means of treatment.

LECTURE XXIX.

Burns and Scalds—Conditions which regulate their Severity—Their remote Constitutional Effects—Treatment—Question of Amputation—Plastic operations for removal of Deformities.

There are very few injuries which are more common or which have received more attention than Burns and Scalds, and in few have so many remedies been proposed.

This class of injuries is divided into two forms: *Scalds*, or injuries inflicted by hot liquids; and *Burns*, which are inflicted by fire or by hot metal.

In estimating the severity of a burn or scald we must take into account several conditions; and it is perhaps more difficult to form a correct estimate in these injuries than in any other. In all other injuries there is a limited force causing them. Here, the effects depend on the radiation of the heat, the length of time that the part has been exposed to it, the extent of surface and depth of tissues involved, the vital importance of the part, and its proximity to important organs. One condition should never be forgotten; and it is this, that the general health of the patient, prior to the injury, has a most important bearing on the result—more so, perhaps, than in any other injury. In burns it makes a great difference as regards the healing process, and as regards operations afterwards, whether the part burned has a large amount of fat under the integument or not. In scalds, we must take into account the nature of the boiling liquid—whether it be water, or oil, or a liquor which retains the temperature longer, and which requires a higher heat than 212° F. for its boiling point; also whether the liquid contains some peculiar substance in solution, and so possesses acrid qualities besides the mere heat. All these conditions must be taken into account in estimating the amount of injury done.

In regard to scalds by boiling water, the temperature can never be above 212° F., and is very generally below it. When the water is upset, a certain amount of temperature is lost by the time it reaches the body, and if the part be covered with woollen clothing—which is a bad conductor of heat—still more of the temperature is lost, as the water permeates through the dress; and so, in many cases of scalds from boiling water, comparatively trifling effects are produced to what we might expect. In cases, however, where the boiling fluid saturates the clothes, unless these be speedily removed, the injury may be inten-

sified. If a person falls into boiling water, then the effects are severe, on account of the water being at the boiling point. If boiling water be applied directly to the surface of the skin it will seldom completely destroy the vitality of the true skin or cutis. It may do so partially, but seldom completely over a large surface, and it never primarily affects the cellular tissue lying under the true skin. There may be effusion, and a slight amount of inflammatory action, but never any peculiar alteration in the cellular tissue—far less in the fascial or muscular textures. In scalds there are generally vesications over the burned part, caused by separation of the cuticle from the true skin. As a general rule, a scald is a less severe injury than a burn. When a scald is produced by other fluids than water—such as boiling oil, or chemical liquids, or in breweries, or, indeed, by any fluid which requires a higher temperature than 212° F. to boil it, there is a greater intensity of heat, and therefore a greater effect produced upon the cutis, the vitality of which may be lost over a large surface, and an unhealthy condition brought on in the subcutaneous cellular tissue. Another point to be attended to in scalds, and also in burns, is that the danger to life depends partly on the extent of surface affected, and also on the part of the body injured. When the surface burnt covers a part of the body not essential to life, the danger is much less than when there is any risk to vital parts. Hence a scalded limb is a less formidable injury than a scald on such parts as the thorax and abdomen, where there is a chance of the contained viscera being affected secondarily. But if a limb or other part of the body be scalded over a large surface, there is a special danger caused by the obstacle so raised to the insensible cutaneous transpiration. This is entirely and completely arrested, and the work must be carried on by other parts of the skin. The irritation and fever, however, which follow upon the injury, prevent this being done properly, and so the kidneys and other internal secreting organs become congested. They have more work to do, and soon cease to perform their functions properly, and this leads to very serious consequences. Sometimes inflammation occurs in serous membranes in cavities, at a distance from the injured part, and the brain may become secondarily affected.

A Burn is caused by intense heat, such as fire, or by heated metal. This destroys the vitality of the part to which it is applied. In burns, as in scalds, various conditions must be kept in mind in estimating the severity of the injury. The clothes of the patient may take fire, and if they are bad conductors of heat, the burns will not be equal in intensity, but will be more severe at some parts than at others. In burns from heated metal, the surface to which it is applied is immediately destroyed; but in accidents in foundries, where the molten metal often falls on the feet, the loss of vitality is not so great as might be expected. This is due to the circumstance of the metal being in contact with the part only for a very short space of time. When it falls on the dorsum of the foot, it immediately rolls off, and does not rest on it for any length of time; but if the molten metal get between the shoe and the foot, so that it cannot roll off, then the vitality of the part is at once and completely destroyed, and great destruction of texture is produced.

In all cases, the local effects of burns by fire are very severe, compared with those produced by scalds. In the one case, we have merely destruction of the skin, and sometimes not even that; while in the burn, there is not only destruction of the true skin and of the subjacent cellular tissue, but beyond that there are changes going on which, though not destructive, have a most important bearing on the after progress of the case. The parts directly subjected to the heat are destroyed, the parts beyond that are also destroyed if the heat has been long applied; the parts, however, beyond that again, though their vitality is not absolutely destroyed, undergo a peculiar change. The cellular tissue under the skin, if the burn has not been sufficiently severe to destroy its vitality, loses its elasticity, and forms a substratum of solid agglutinated material, which prevents the contraction of the wound afterwards, and to this is to be attributed the slow healing of the wound. This solid substratum drags the skin from all directions, causing great deformity sometimes, and under it the muscular texture is generally affected also. This is a most important peculiarity in burns. Contrast a burn with the eschar made by a potential cautery, which destroys the vitality of the skin and cellular tissue. The eschar separates, and the wound gapes, but then the healing action begins, inflammation and swelling subside, the cellular tissue is not affected as in the burn, the wound contracts and heals readily, and there is no cicatrix, except at the point where the caustic was applied. In a burn involving the same extent of surface, however, the healing process would be slow, and would leave much greater contraction and a harder cicatrix on account of the heat radiating deeper and affecting some of the textures permanently, consolidating them, and so causing a mechanical hindrance to their healing by contraction.

Scalds and burns have certain dangers in common. One of these is the interruption to the cutaneous transpiration, and also the irritation produced by a large surface being affected with intense pain. The first effect noticed from a burn or scald is the shock or collapse, and this is very great when the injury is severe. The pulse is weak, the skin which has not been injured is cold and clammy, the patient has a sunken look, and though great pain is felt, it is somewhat dulled at first by the shock. Even when the body is charred in a great measure, and the pain is very great, still, looking at the amount of surface burned, and the severity of the accident, we wonder how little complaint of actual pain there is. There is a feeling of restlessness and of numbness from the very severity of the injury. But though the expression of pain is not so great as might have been expected, the pain must be intense.

The *Treatment* of these injuries must be conducted with care, tenderness, and promptitude. The state of collapse resulting from the intense irritation and suffering must be met very energetically, for during this stage death often ensues. In scalds this danger is sometimes very great, but it must be met with somewhat more caution than in burns, where the risk of death during collapse is also great.

In scalds, the patient very frequently gets over the first shock, but if there has been any over-stimulation then there is a great risk of secondary dangers coming on. In these injuries, therefore, the stimu-

lation must be carried on more cautiously than in burns. Opiates in large doses, to relieve the pain, should be given rather than stimulants. A small quantity of the latter may be given from time to time. And of these the best is champagne, with a little brandy. But the effect of these must be carefully watched. The use of opiates is absolutely indicated to procure rest, and relieve the pain and suffering. And they also—especially with antimony or ipecacuan—act as diaphoretics, and determine towards the skin, and so relieve the risk from the arrested cutaneous transpiration. When the burn is very severe—so much so as to be almost a hopeless case—while we give stimulants from the first, we must also do more than give opiates to relieve the pain. And here the use of chloroform is indicated. It should be given only in sufficient quantities to soothe the patient; and in this way he can be rendered insensible to the pain for a long time.

As regards the constitutional effects of burns: We must keep in mind the liability of certain organs to become affected from their proximity to the burned part, or from other causes, as œdema glottidis resulting from burns of the mouth and congestion of the lungs in burns or scalds of the thorax. We must watch in such cases for the symptoms of congestion coming on, and meet them on the general principles of treating such disorders; but these are not cases in which active depletion may be resorted to, to relieve the congestion. When the kidneys become congested, from the arrested cutaneous transpiration, we must be careful not to stimulate them by giving strong diuretics, such as the sweet spirit of nitre. In these cases, aerated potash water with fresh lemon-juice answers very well; it acts on the kidneys as a diluent without over-stimulating them. We must watch for any symptoms of acute albuminuria coming on, and if these occur, we may require to apply leeches or a poultice or sinapism over the kidneys, so as to relieve the congestion of the organs in the first instance, and give internally small doses of Dover's powder, with the potash water, or the acetate of potash in solution.

Ulceration and perforation of the duodenum is said to be a frequent morbid condition in cases of severe burns; but I have not seen the lesion in any case where I have had an opportunity of witnessing an examination of such cases after death.

The number of local applications which have been proposed for burns and scalds is very great; amongst others, turpentine, oil, collodion, vinegar, flour, wadding, and carbolic acid, all have been used with more or less success. One point should be kept in mind—namely this, that the patient feels great relief from having the part protected from the air, and from the pressure of the bed-clothes, and therefore the use of cotton wadding wrapped round the limb answers very well. If a scald be seen at the very first, before any vesications have risen, I know of no better application than cold-water cloths placed round the limb. This immediately relieves the pain, and often prevents vesications from rising. But if the vesications have risen, then before applying cold-water cloths or any other dressing whatever, we should let out the fluid in the vesications with the point of a needle or a pair of scissors, so as to smooth down the cuticle. If the cuticle be ruffled we

expose a raw irritable surface, which does much harm. Afterwards we may apply a piece of lint soaked in Carron oil, or even in cold water, and then wrap some wadding round the limb, and in many cases, with rest and proper internal treatment, the part will heal readily without much irritation or pain.

In burns, the best plan is to wrap the part in wadding at once. Mr. Liston used to object to this treatment, considering it to be a dirty application, and instead of it he used to apply flour to the part, so as to form a crust on it, and when the discharge soaked through more flour was dusted on till a sort of paste was formed. But this never appeared to me to be a very clean application ; it forms a mass of dirt inside with a little clean flour on the top, and in my opinion is not so cleanly as the wadding. When there is much irritation and inflammation, or where a large surface is burned, then warm-water lint, or a soft poultice, may be applied instead of the wadding. Carron oil is another application often used, and in many cases relieves the pain, and besides allows the dressing to be more easily changed.

In severe burns and scalds of the extremities, where a large raw surface is exposed, the use of the tepid-water bath is preferable to any other method (plate x. fig. 2). The water may either be simple or medicated, and by suspending the limb in this, all pain and irritation consequent upon change of dressings are obviated. More especially is it useful in burns, inasmuch as it keeps the tissues supple and mobile during cicatrisation, and permits gentle movements of the limb to be commenced at an early period after the injury.

As regards amputation—either primary or secondary—in cases of burns and scalds : Primary amputation is sometimes, though not often, required when the limb is very much burnt; but here there is a difficulty in calculating the extent of the radiation of the heat, and how far the injury is limited. In many cases, where the burn reaches much above the middle of the arm, I would amputate at the shoulder-joint, because the risk of the weak action or sloughing extending is very great, and the operation is not more dangerous than sawing through the humerus. It is not generally difficult to decide whether to amputate secondarily or not—when the patient is becoming exhausted from the irritation and discharge, and when it is desirable to remove deformity, as in the limbs I show you. The limb should be amputated, and very soon afterwards the patient's general health becomes re-established. The difficulty is in the intermediary class of cases, where the irritative fever still exists along with discharge, and where every dressing of the wound is attended with great suffering—then we must do something to relieve the patient, though the chances are much against amputation. I have performed the operation under such circumstances, in some cases successfully, but the results are not usually so. But now with the tepid-bath system this should hardly be required at all, as all dressing is thereby avoided. The intense amount of suffering, however, would alone produce death, and so we are forced to amputate sometimes by way of giving the patient the only chance. The operation relieves the intense sufferings, and acts as a palliative; and although the chances of recovery are very small

indeed, still we are bound to give the patient what little chance there is.

Operations are sometimes required secondarily on account of the great contraction of the parts, which is caused by agglutination of the textures. In such cases we require not merely to cut across the tight band of skin, but to dissect it from the agglutinated tissue, going beyond it into the healthy textures, and bringing the margins together in the longitudinal direction. Or we may do it by dissecting and transplanting flaps of healthy skin to fill up the gap. In some cases, after such operations on the limbs, splints must be applied to prevent contraction from again taking place. If we leave any part of the tissue undissected from the agglutinated base, the wound will not heal readily. In the arm I have frequently operated in this way with good success; but in the cases of great contraction of the face and neck, the chances of a good result are doubtful.

There is much careful consideration required in determining on the propriety of operating, and in planning the mode of procedure in these cases of deformity resulting from burns. And though it is impossible to lay down rules for such irregular operations, as each case demands its special consideration, yet, before concluding this lecture, I think it may be useful to indicate in a suggestive form the principal points to be kept in view.

As regards the propriety of operating: We should ascertain the length of time for which the contraction has existed, and whether the injury was received in early life.

In many cases where the contraction has existed for a long series of years, and especially if the burn occurred in childhood, or indeed before adult life, the changes are not confined to the soft textures. The bones and joints in the vicinity have probably undergone such alteration in form and structure, as to render removal of deformity or restoration of the parts to their natural state quite hopeless, and so to contra-indicate operative interference. Thus in cases of contractions following extensive burns of the face and neck or upper part of the chest, such as that represented in the accompanying woodcut, the

Fig. 18.

Fig. 18. Deformity arising from the contraction of the cicatrix of a burn of the neck. Chin dragged down upon the chest.

temporo-maxillary articulations are often either completely anchylosed or altered in form and movement; whilst the ascending and horizontal rami of the lower jaw are so changed in form and relation to each other as to resemble the jaw of some of the lower animals. In such cases operative interference can only end in failure.

The same considerations apply to similar contractions of the limbs of long standing resulting from burns, and in which the muscles are probably altered in structure. But all rules have exceptions. I have operated successfully in relieving the contraction of the soft parts by excising an anchylosed elbow-joint resulting from a burn.

In cases in which the soft textures alone are implicated, we should keep in view the original extent of skin destroyed, so as to be able in some measure to calculate the amount required to fill up the gap which will result from the retraction of the skin which had been dragged from neighbouring surfaces when we free the contraction. Unless the operator takes this into consideration he may find himself very awkwardly placed. In many cases the original extent of lost skin is such as to forbid operation.

There are certain conditions favourable to success in these cases, such as a large amount of subcutaneous fat, as its absorption permits of the skin closing in with less subsequent contraction. The natural laxity of the skin also, in certain regions of the body, such as the abdomen and perineum, permits of the healing process progressing more quickly, and with less contraction and deformity than in such regions as the scalp or back.

Finally, as regards the method of operation. I have already told you that we must not be content with merely dividing the contraction. We must dissect the agglutinated and altered texture of the cicatrix. In most cases we require to transplant skin to fill up the gap, and in doing so we must be careful to keep flaps of sufficient thickness, and avoid twisting, dragging, or anything likely to interfere with their vascular supply.

There is always a risk of a very large or long flap losing its vitality, either in whole or part, and hence I often prefer two or more smaller flaps of skin, so that their nutrition may be less imperilled.

LECTURE XXX.

Traumatic Tetanus—Period of Invasion—Symptoms—Pathology—Treatment.

Having now considered the various forms of wounds and their treatment, we come to examine the nature of Tetanus, one of their most formidable consequences (plate x. figs. 1 and 3). This disease is evidently one commencing in the nervous system, affecting the muscles secondarily, and is characterised by violent and persistent, or at least long-continued, contractions of the muscular system.

Although most frequently the result of injury, it occasionally occurs without obvious cause, and hence it is classified under the heads of Traumatic and Idiopathic Tetanus. It is with the former that we, as surgeons, have principally to do.

Traumatic tetanus may result from any injury; for although it is most likely to follow laceration, or injury to nerves in punctured wounds, it occasionally occurs after an incised wound or a trifling abrasion, especially in warm climates and during the rainy season. In this country tetanus generally occurs in spring or at the end of autumn, when the weather is wet and changeable.

In cases of traumatic tetanus the symptoms rarely appear immediately after the injury; generally from eight to ten days afterwards; sometimes, when the healing process is nearly completed. One of the worst cases of tetanus I have seen commenced in this way: The patient had suffered from a burn on the arm, for which he attended my ward at the Infirmary as an out-patient. Some time afterwards, when the burn was almost cicatrised, he was seized with tetanus. He was taken into hospital, and treated in the manner presently to be described, and, I am happy to say, recovered.

There is usually a short premonitory stage, but it is often so slight as not to attract attention; there is a feeling of some uneasiness and stiffness about the neck and face, which the patient perhaps attributes to the effects of cold. He next feels increased stiffness about the same parts, with twitching pains. The features have a peculiar expression; the facial muscles are more pronounced; the eyeballs are more prominent, although the eyes appear smaller from approximation of the eyelids; the lips seem thin and drawn inwards, the mouth being sometimes twisted to one side. These appearances are, however, subject to exceptional variations. The jaws get gradually stiffer till the patient becomes unable to open his mouth; there is a constant painful contraction of the masseters; while during the attack the muscles are rigid as iron. This condition lasts for a time, and then passes off, but soon

Plate X

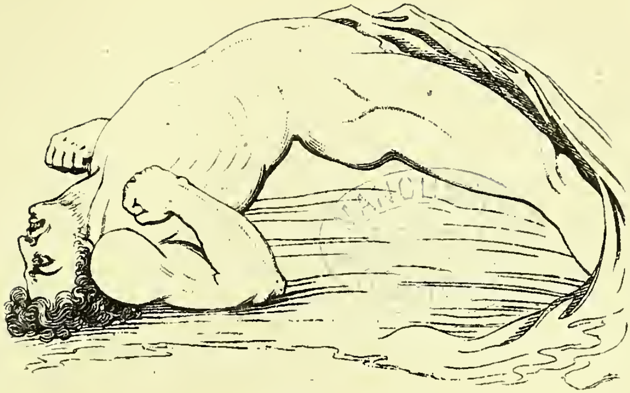

Fig. I.

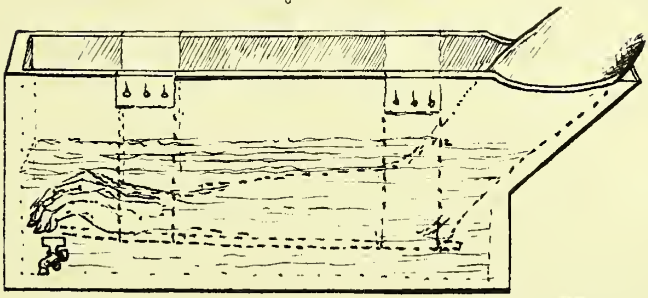

Fig. 2.

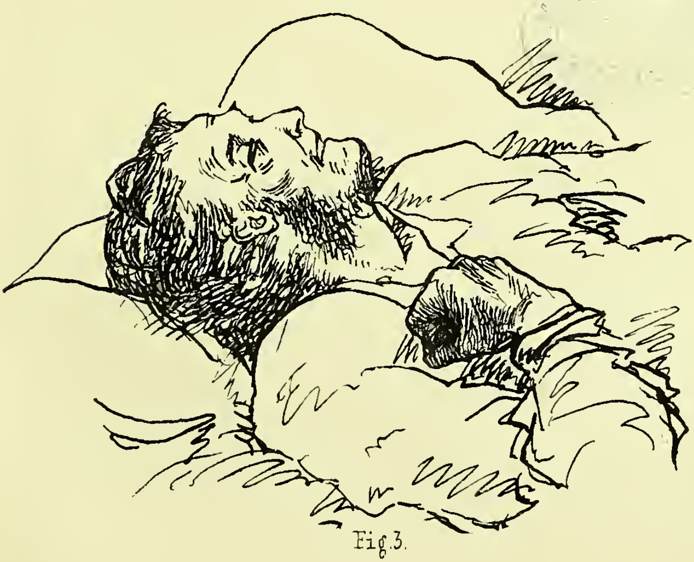

Fig. 3.

Waterston & Son Edin. Lith.

returns—the intervals between the attacks always getting shorter, and the paroxysms becoming more severe and more marked. The head is bent to one side or backwards; there is sometimes pain over the abdomen and in the limbs, till at last the whole muscles of the body, or a system of muscles, are involved. In some cases the erector muscles are affected and the body is bent backwards, giving rise to opisthotonos (plate x. fig. 1); or the muscles on the anterior aspect of the thorax and abdomen may become rigid, and the body is then bent slightly forwards, causing emprosthotonos, but this condition is neither so marked nor so common as opisthotonos. There is also a peculiar pain extending from the ensiform cartilage towards the spine, accompanied with great difficulty of breathing—a condition due apparently to spasm of the diaphragm. In fatal cases the patient may die gradually exhausted, but more generally he dies from asphyxia during one of the spasms of the diaphragm and intercostal muscles. Sometimes, in a very early stage, the patient finds it almost impossible to swallow, especially hot or cold fluids, as these stimulate the throat, and lead to the paroxysms. This symptom might make us think the case to be one of hydrophobia, but the other symptoms can scarcely be mistaken.

We know very little about the general pathology of tetanus. In the traumatic form we have the lesion of the superficial nerves giving rise to irritation in the nervous centres, and these reacting upon the muscles. In many cases we find the injured nerve inflamed, the neurilemma more vascular than usual, and irritated at the injured point, and we infer that the excitement of the distal part of the nerve has led to the disease of the nervous centre. The post-mortem appearances in tetanus are similar to those of all spasmodic or convulsive diseases: there is engorgement of the veins about the spine, depending on passive congestion of the part; and there is always more or less serous effusion; but these conditions may be produced by the very symptoms which preceded death—the spasms and convulsions. There is seldom much irritation of the mucous membranes, or internal congestion of organs, except the nervous system, though in some cases the great vessels of the lungs are congested. The distinctive appearances of the disease are, the irritation of the nerves injured, which are inflamed and irritable for some little distance upwards, and also the congestion and increased vascularity of the medulla spinalis, and especially the congested condition of the rachidian veins.

Treatment of Tetanus.—The first thing to be done is to allay the irritation, and to get rid of the exciting cause by removal of any foreign body which may be present—by the division of partially divided or torn filaments of nerves, as in lacerated wounds—by making a clean incision round the torn part, or by amputating the limb if it be not too late. After any foreign body has been removed, poultices, either simple, or medicated with solutions of tobacco or opium, or warm anodyne fomentations may be applied, or the injured limb slung in the warm-water bath, which may be medicated with opium or tobacco.

At one time the number of infants who died in the West Indies from trismus or lock-jaw was very great, and on examination it was found that the midwives attending the mother during confinement

used to apply remedies of their own to the cord of the infant, which led to great irritation, and when these were done away with and soft poultices applied, the number of deaths was greatly diminished.

Besides removing the source of irritation, we must also use active measures towards relieving the congestion of the spinal marrow and its membranes, which leads to muscular spasms. For this purpose, cupping along the course of the spine may be resorted to: where the patient is robust and healthy we may use the wet-cupping, but when much depletion cannot be borne the dry-cupping should be employed. The use of warm fomentations, and rubbing in the extract of belladonna with some mercurial ointment and opium along the spine, will be of benefit. Internal remedies are also to be given, such as opiates, and specific remedies, such as the cannabis indica, which acts as a sedative, but still maintains the force of the pulse without increasing its frequency. Extract of Calabar bean is also strongly recommended, and this acts apparently directly on the nerve centres. Whether we give opium, cannabis indica, or Calabar bean, one point to be attended to is, that the medicine should not be given in a solid, but in some easily diffusible form. Large quantities of opium are given in tetanus without producing any effect, and after death it has been found undigested in the stomach. This shows that the medicine ought to be given in a liquid and not in the solid form. By some, opium is supposed to produce congestion and excitement of spinal cord, and to be on these accounts objectionable. The best method of exhibiting the cannabis indica is to drop the tincture on a little raw sugar, as the resin becomes concrete if we mix it with water. In many cases we find that, by introducing a tube into the rectum, by which the vapour of the cannabis indica may be injected as it were, the system becomes very readily affected; and this is specially useful when the patient cannot swallow from the trismus being complete. Subcutaneous injection of cannabis indica, morphia, or extract of Calabar bean, is a very good method of administration.

Various other remedies have been proposed; among them calomel and opium are generally resorted to. Mercurial preparations are sometimes rubbed over the spine and groin; but I have never seen any good effects produced by these remedies. The alkaloid curarine, the active principle of the woorara poison, has been used as a subcutaneous injection, but with little success.

In most cases the bowels are obstinately constipated, and the use of active purgatives is requisite. As there is often even at first a difficulty in swallowing, the use of croton oil in a little mucilage will be found the most manageable form.

It is stated by some writers that retention of urine occurs in consequence of spasm at the neck of the bladder; but although I have treated many cases of tetanus, I have never seen this condition, but usually the opposite, from the contractions of the detrusor urinæ.

Ice to the spine or cold affusion is often very beneficial in relieving the spasms for a time; the patient should be placed in a bath, and cold water dashed upon the spine and back, but this, like other remedies, gradually loses its power. Warm affusion and the warm bath have long been used, but the patient cannot be kept for any great length of

time in the bath. Chloroform given internally, and also by inhalation, checks the convulsive spasms, and when combined with cannabis indica often affords great relief. But, after all, when once the disease has gone a certain length, it gets beyond our control, and our remedies can do little good.

If the exciting cause of the tetanus be a wounded limb, ought we to amputate and so remove the source of the irritation? I have done so myself in some cases; but I never saw any benefit derived from it. If the part injured be a finger only, and if the operation be performed at the very first, before the symptoms have made any great progress, the result may be favourable; but after the disease has progressed—when the trismus and spasms have become marked—or when the disease has passed beyond stiffness in the neck and difficulty in swallowing, then amputation will do no good, as by that time the disease has been propagated to the nervous centres. In the larger amputations the patient often suffers from the effect of the operation, and the symptoms of tetanus become more marked and more severe than they were before the amputation.

In cases where recovery takes place very great care is requisite as to diet and regimen during convalescence, avoidance of all excitement or exposure to cold or draughts of cold air. In many cases, however, it is wonderful how rapidly the patient recovers when once convalescence sets in.

CLINICAL CASES.

HISTORY OF A CASE OF RECURRENT TUMOUR.

(*Referred to at Page* 111).

The position of this class of growths known as "fibro-plastic," or "recurrent," tumour, as to its vital characters, has been, and indeed still remains, a matter of uncertainty. The question as to whether they should be classified as "simple" or "malignant" is still undecided. Their histological character seems to indicate the former, whilst, on the other hand, the history of most of the cases on record points to the malignancy of their nature.

With reference to this point, the case of Mrs. Easton, narrated below, is of peculiar historical interest, inasmuch as it was one of the earliest cases in which the marked tendency to recurrence, without any other feature of malignancy, drew the attention of the profession to this subject. As we now have before us the completed history of this case—extending over the long period of forty years—I think a consideration of all the circumstances may assist us in forming an opinion as to whether this, perhaps the most typical case of recurrent growths on record, should be relegated to the simple or malignant class, or stand apart from both, as a tumour *sui generis.*

Jane Easton first consulted the late Dr. Maclagan in the year 1832. At that time she was 22 years of age, and applied for advice in consequence of a tumour of some three years' growth, situated in the left lumbar region, about one inch from the spine. It was about the size of a jargonelle pear, firm, but elastic in consistence, and freely movable. Below the tumour the skin for some little distance was indurated. The tumour, and also the adjoining diseased skin, were removed, and the growth was, on examination, found to present the ordinary characters of a simple fibrous tumour. About a year afterwards, however, a recurrence of the growth took place, in the form of three small tumours, situated in the cicatrix, resulting from the former operation. These tumours, together with the scar, were thoroughly removed by Dr. Douglas Maclagan in 1834 ; but again, eighteen months later, the growth for the third time appeared in the same situation as before. After increasing in bulk for a year and a half, this also was removed by Dr. D. Maclagan, and was found to possess the same firmness and elasticity, and to present the same semi-transparent pinkish-gray colour, as was noticed in the original tumour.

For a considerable period subsequent to this operation, no further recurrence took place, and it was not until the month of March 1857, *i.e.* about

twenty years after the removal of the third growth, that she again came under treatment. On this occasion, Dr. D. Maclagan requested me to see this patient, with a view to the removal of another tumour which had made its appearance in the old cicatrix about a year previously. The tumour was now about $2\frac{1}{2}$ inches long, by about $1\frac{1}{2}$ inch broad at its widest part, and about $1\frac{1}{2}$ inch in depth at its thickest part, slightly elastic to the touch, and somewhat irregular on the surface, its prominent portion presenting a peculiar transparent pinkish appearance.

I removed the tumour and also the cicatrix widely from the surrounding skin; and conceiving that there might be some connection between its recurrent growth and the existence of neighbouring fibrous tissue, I dissected off a considerable portion of the lumbar fascia subjacent to the tumour and scar. At this time the general health of the patient was excellent, and there was nothing in her complexion, tongue, pulse, or general appearance, at all indicative of malignant cachexia. The wound healed well, and I saw her occasionally for some years afterwards; there has, however, been no further recurrence of the tumour in the lumbar region.

The tumour on this occasion was sent to Sir J. Paget and to Dr. Haldane, and the structure was found to consist of fibrous tissue, containing nucleated cells of an elongated oval form.

In November 1868 Mrs. Easton again came under my care, this time because of a tumour, about the size of half a small melon, which had made its appearance in the right mamma, the nipple of which was slightly retracted. In consistence the tumour was firm, even hard at some parts. No enlargement of the lymphatic glands, either in the axilla or in the subclavian space, could be detected. The patient's general health was good, and beyond the anxiety and nervous depression, occasioned by the existence of another tumour, her appearance was but little altered from what it was in 1857; less so, indeed, than one would have expected the lapse of time to have made in a woman at her period of life. I operated at once, removing the tumour and also the mammary gland. The patient made a good recovery.

On the 27th of August 1870 Mrs. Easton again applied to me on account of a second growth in the breast, in the vicinity of, but not connected with, the cicatrix of the last operation. The tumour had been growing for some months, and had now attained the size of a small lemon. The patient's general health was good, and her condition much the same as formerly. On the 31st I removed this tumour, and during her convalescence from the operation, she stated that she had great difficulty in swallowing solids, the nurse informing me at the same time that she had taken nothing but fluid food for some days. I therefore proposed passing the stomach-tube, in order to ascertain whether any organic change had taken place in the œsophagus; this she objected to very much, and the next day she swallowed solid food, and informed me that the difficulty in swallowing had passed away. As these symptoms seemed to have arisen suddenly, and to have passed away as suddenly, I thought, taking into consideration her nervous state, that the difficulty had been spasmodic, and due to hysteria; and, moreover, as she now took her food without difficulty, I did not press for an examination with an instrument. She left the hospital apparently in good health, coming back occasionally for some months afterwards to show herself. The breast continued quite free from any further recurrence of the growths, and both cicatrices remained perfectly sound.

Characters of the Breast Tumours.—"Hard, almost stony, and painful. Axillary glands not enlarged. Section of tumour was concave; its colour

dullish white, with yellow spots, and contained a cyst which had smooth vascular walls, and puriform contents. The tumour had in part a well-defined outline, but in part was blended with the surrounding fat and areolar tissues. The cell-forms making up the chief part of the tumour were circular or oval, or caudate or irregular stellate, and they lay in an ill-defined trabecular structure."

I heard no more of Mrs. Easton until June 1871, when Dr. Claud Muirhead called, at the request of Professor Maclagan, to inform me that she had been visiting some friends in the west of Scotland, where, in consequence of catching cold, she had been suffering from broncho-pneumonia and pericarditis. She had with great difficulty been brought back to her own home, where she was then lying in a hopeless condition.

I at once visited her, and found her in a dying state. She had not been able for some time to swallow even fluids, except in very small quantities, and very slowly. I was also informed that a swelling had formed in the armpit, near the scar left by the operation for removal of the last mammary tumour, and that the swelling had softened, burst, and discharged a considerable quantity of matter. There was a large ulcerated aperture left, whose surface had a dirty appearance, as if from want of action. As she was moribund, I could not advise anything beyond nutrient enemata.

She died shortly after my visit.

A post-mortem examination was made by Dr. Wyllie, of which the following is the report taken at the time :—

Autopsy by Dr. Wyllie.—Body somewhat emaciated ; face pale and sallow. Over the right mammary region there was a linear curved cicatrix, five inches long, extending from the junction of the third costal cartilage with the sternum to the inferior margin of the pectoralis major in the axilla. The convexity of the curve was downwards, opposite its outer extremity ; an inch and a half lower down was a second curved cicatrix, two and a half inches in length, with its convexity upwards. From the outer end of the longer cicatrix a gaping wound extended into the axilla, measuring three inches in length, and two inches in breadth at its widest part. The bottom and edges of the wound presented a grey phagedænic appearance, and were coated with a dirty greyish-green discharge, which, under the microscope, was seen to be made up of a large amount of fatty débris, mixed with degenerated granular pus-cells. The tissue forming the base of this wound was *tough and fibrous*, being composed for the most part of connective tissue, which under microscopical examination appeared very abundantly nucleated, much more so than ordinary connective tissue ; this was especially noticeable after treatment with acetic acid. The nuclei were small and oval in shape.

Above the wound, the lymphatics along the course of the axillary artery were slightly enlarged. On the skin of the back, over the inferior angle of the left scapula, there was a small pedunculated tumour about the size of a filbert. This tumour was simply a hypertrophy of the cutaneous structures, especially the cutis vera ; and under the microscope it presented an abundance of common areolar tissue.

Thorax.—On opening the thorax, the outer surface of the pericardium was seen loaded with a considerable deposit of fat. The parietal layer of the pericardium was everywhere adherent to the visceral layer, the adhesions being recent, and easily separable, lymph soft and partially organised.

Heart itself quite healthy.

Left pleural sac contained three pints of clear yellow serum. The pleura itself was dotted all over with numerous small white nodules of a fibrous

consistence, varying in size from a millet-seed up to a pea. The microscope showed these to be *formed of fibrous tissue very abundantly nucleated, similar to that before described as forming the base of the axillary wound.*

The left lung was much diminished in size from compression, the lower half of the inferior lobe being especially shrunken, and on section appearing carnified or collapsed, sinking in water, whilst the upper lobe was also much compressed at its lower margin, but emphysematous at the apex and anterior margin. At the root of the lung, the walls of the greater bronchial tubes were much thickened, and the tissues around indurated, this being due to the *presence of an excess of connective tissue.* Right lung and pleura healthy ; at the root, however, the larger bronchial tubes presented the same thickening and induration noticed in the left lung.

Tracheal and bronchial mucous membrane congested.

Œsophagus.—About two inches above the cardiac orifices of the stomach was a stricture, with indurated and thickened walls, firm and fibrous on section. Length of the stricture, one inch and a half ; indurated wall, half an inch in thickness, reducing the lumen of the passage to half its natural size. Opposite this stricture, the œsophagus and the aorta were bound together by very dense fibrous adhesions. Just above the stricture, and situated anteriorly just below the bifurcation of the trachea, was a small cul-de-sac, about the size of a pea, the fundus of which was bound to the indurated tissue between the bronchial tubes.

The thickening of the œsophageal wall at the point of stricture, when examined under the microscope, showed a simple fibrous structure, no excess of nuclei ; in short, nothing but the elements of ordinary connective tissue.

Abdomen.—Stomach healthy, abundance of mucus. In large intestine, numerous hard scybalous masses. Liver congested and fatty, normal weight and size ; spleen and kidneys healthy.

Uterus.—In this organ were three fibroid tumours. The most inferior and largest was about the size of an orange ; it was attached to the posterior uterine wall from the level of the os internum to the fundus. The remaining two were about the size of an apple and a walnut respectively, and were situated on the top of the first, projecting upwards from the fundus towards the brim of the pelvis.

Microscopical examination of these tumours showed them to be simple fibrous growths ; and the usual whorled and interlaced arrangement of fibres on section was plainly seen by the naked eye.

Remarks.—I have elsewhere, in contrasting the case of Jane Easton with other similar cases of recurrent fibro-plastic growths, referred to it as being, so far as regards my experience, the only one which the progress of the case did not mark as malignant ; and I may now illustrate this peculiarity by referring to two cases which greatly interested me long before Mrs. Easton's case came under my notice. The former of these was under the care of the late Professor Goodsir, who asked me to see the case. The patient, a man of about 35 or 40 years of age, had a tumour about the size of half a lemon—cut longitudinally—situated over the left hypochondriac and epigastric regions of the abdominal parietes. A similar tumour had been removed from the same position, by a surgeon in the country, some fourteen months previously, the resulting scar being now covering the new growth, which was well defined, firm in consistence, and freely movable. The patient

said he felt perfectly well, but his general appearance was not very promising; indeed, his anxious expression and sallow complexion, etc., led both Professor Goodsir and myself to form rather an unfavourable prognosis.

Professor Goodsir removed freely the tumour and cicatrix from the surrounding parts; the wound healed rapidly. Microscopic examination exhibited all the characters of a fibro-plastic growth; but in addition, there was also noticed embedded amongst the fibrous structures a small amount of tubercular-looking matter, which showed a few cells of somewhat irregular form.

At the time of the operation, we noticed what appeared to be a small wen on the patient's scalp, about the size of half a small marble, which, in the course of two months, increased to the size of a hen's egg. Professor Goodsir removed this, and it was found to possess the same character as the tumour previously removed from the abdominal walls.

I heard nothing further of this case until a year and a half afterwards, when I saw the late Professor Syme remove another tumour from the epigastric region. This tumour was very irregular in form, and much larger than the former growths. On section, its texture seemed soft and medullary in character, but I am not aware that any miscroscopical examination was made. At this period the general appearance of the patient was much altered, he being very thin, sallow, and haggard. Within a year I again saw Mr. Syme remove a large tumour from the same position, which on section had all the appearance of medullary sarcoma; and I was informed that this patient died some few months later, with all the symptoms of a malignant cachexia.

The other case to which I have alluded was that of a young woman, who applied to me on account of a growth on the outside of the thigh. It had attained a considerable size, but was quite movable and well defined. To the feel it was very like a fibrous growth, but perhaps rather softer. The surface of the tumour was marked by a long linear scar, and on my inquiry as to the cause of this, the patient told me that Professor Syme had removed a similar growth two or three years before. Professor Syme informed me that the former growth was fibrous, and said he had no doubt the case was one of recurrent fibroid tumour. The patient refused positively to undergo another operation (this, I may mention, was before the introduction of chloroform), although she was urged to do so both by Professor Syme and myself. About eighteen months afterwards she sent for me, when I found her in a very exhausted state. The tumour had, by its irritation locally, caused ulceration of the skin, and had almost spontaneously separated *en masse.* The edges of the sore were everted and irritable, the sore itself discharging profusely, giving rise to a most disagreeable odour. As the tumour was now held only by a few shreds of areolar tissue, I cut them through, in the hope that the removal of the source of irritation would allow the large wound to heal. However, the ulceration extended superficially, and also affected the deeper textures, just as a cancerous ulcer does, and the patient gradually sank from exhaustion.

It has always appeared to me that both these cases were merely modifications of medullary sarcoma. From a very early period, indeed

the appearance of the patients and the general symptoms were suspicious, whilst the rapid return and degeneration of the growths themselves, especially accompanied by increasing evidences of a constitutional cachexia, could leave little doubt of their malignancy. In the case of the young woman, the progressive and aggressive character of the ulceration, after the removal of the tumour, seems to me still more decisive.

I have before said that the progress of Jane Easton's case did not mark it as malignant, and hitherto I have spoken of it as being the only case of "simple recurrent tumour" I had met with.

With the whole case and circumstances now before me, the questions arise, How far am I still warranted in holding that opinion? or, Do the ultimate circumstances indicate such a malignant cachexia and secondary involvement of other structures as we meet with in medullary sarcoma or carcinoma?

We had undoubtedly a remarkable tendency to recurrence, and also another feature of malignancy in the appearance of similar growths in other parts than the region primarily affected, *e.g.* the presence of fibrous growths in the uterus, the small tubercles growing from the pleura, and the organic alterations in the œsophagus. But there are, I think, other conditions and facts which should make us hesitate before we classify the case as malignant. Neither in the lumbar nor yet in the mammary region did the structural characters of the growths vary much. In the lumbar region the successive tumours maintained identically the same structural appearances from first to last, whilst the peculiar texture of the mammary gland would account for the slight difference in that region.

The great feature, however, in Jane Easton's case was the fact that up to the time when she was attacked by the illness to which she succumbed, her general health remained unaffected; and I cannot see any connection between the attack of pericarditis and broncho-pneumonia, which was the immediate cause of death, and the original disease. It is true, however, that she was suffering from dyspeptic symptoms and difficulty in swallowing prior to her last illness, and this had undoubtedly weakened her somewhat; hence I was rather suspicious as to the state of the œsophagus. The post-mortem examination, however, showed it to be a simple stricture, occasioned by an increase of white fibrous tissue; and there can be no little doubt that it must have existed for a long time and progressed slowly, though, from her dread of an instrument being passed, she seems to have concealed it to the last.

As to the tumours of the uterus, these were found to be the simple fibrous growths so common in that organ, and their existence should, I think, be regarded rather as coincident with than as dependent upon any constitutional condition or malignant tendency.

In conclusion, taking into account all the vital manifestations, I cannot classify this case as malignant; whilst conversely some of the circumstances—such, for instance, as the development of secondary growths in the mamma, axilla, and pleura, and the superabundant development of connective tissue, nucleated in greatly larger amount than usual, in various organs—seem to withdraw it from the simple

class. I am, therefore, strongly inclined to consider it a tumour *sui generis,* the type of a class whose peculiarity is the tendency to recurrence without constitutional degeneration.

CASES ILLUSTRATIVE OF GUNSHOT INJURIES WHICH OCCUR IN CIVIL PRACTICE.

Gunshot wounds have been so generally considered as the province of the military surgeon, that comparatively little attention has been bestowed upon the peculiarities of wounds from firearms occurring in civil practice, for although many isolated cases, possessing great interest, are to be found scattered through the records of surgery, our principal systematic works scarcely allude to them. I have, therefore, thought it might be of some practical service to select a few cases illustrative of different forms of such injuries, and draw attention to what seem to me their peculiarities, contrasting them with similar lesions inflicted by ball; so that the general principles deducible from them might be arranged in a more distinct and systematic form. To many these principles may seem commonplace and obvious, from the nature of the projectile inflicting the wound; they are not, however, so obvious but that mistakes do not occur; and as the injuries are of a kind which require prompt and decided action, and, moreover, frequently occur in country districts, where the surgeon has no means of obtaining further professional aid, I think there may be practical good done by drawing attention to the subject.

I would classify the cases which are the subject of the present communication under the following heads:—

1. Injuries inflicted by the discharge of firearms loaded with small shot.
2. Injuries inflicted by firearms charged with powder and wadding, or with paper pellets.
3. Injuries inflicted by the bursting of firearms.

Class I.—Injuries inflicted by Small Shot.

In regard to the injuries under the first head, I will only speak of those which are inflicted by the weapon being discharged at a comparatively short distance from the person wounded; for, if the distance be considerable, the shot are so scattered and the force diminished, that in general the injury is but slight, except where a stray pellet strikes some important and delicate organ, as the eye.

In the cases where the discharge takes place close to the part injured, the nature of the wound is very severe, and attended not only with all the dangers of a bullet wound, but with others peculiar to itself, from the greater amount of laceration and destruction of parts, caused by the expansion and scattering of the charge after it has entered. There is more primary hæmorrhage, in general, than in bullet wounds, from the way in which the vessels are torn; and this

risk will be greater where the charge of shot is contained in a wire case, for, as it expands and bursts on meeting resistance, the sharp portions cut the textures with which they come in contact. The larger arteries and their sheaths may also be injured, so as to slough and give rise to secondary hæmorrhage. This class of injuries may be described in general terms as contused and lacerated wounds, but liable to such grave complications as render them peculiarly dangerous.

The external appearances will vary according as the charge enters *en masse*, and then passes out at some distance, or as it strikes obliquely, raking the parts. In the former case the opening of entrance will be small and round, but larger, more ragged, and less depressed than a bullet wound, while the opening of exit is always a large lacerated wound. In those cases where the shot rakes obliquely, the skin and fascia are torn off, and the deeper textures ploughed up by the shot, exposing a large, ragged, and contused surface.

The first of the cases I shall allude to under this head will serve to illustrate the general character of a penetrating flesh wound of this kind, as contrasted with a similar bullet wound.

Case I.—Several years ago I was sent for by Mr. Falconer of Loanhead, to see a man who had received a severe gunshot injury of the thigh. The patient was a young man about 21 years of age. Whilst ascending a bank, trailing his fowling-piece, the trigger was caught and the gun discharged, the muzzle being close to his right thigh at the time. The charge entered *en masse* by a rounded opening on a level with, and a little behind, the great trochanter, and passed out by a long, ragged, slit-like aperture on the outside of the knee, about two inches above the head of the fibula. A medical man, who had been called to the patient in Mr. Falconer's absence, had adopted the rather novel procedure of carefully closing both apertures by continued suture. On removing the stitches and enlarging the upper opening, I found that the charge had passed down superficially, tearing the fascia lata into shreds, and ploughing up the surface of the vastus externus. From the laceration of the textures in the track of the shot, and the extent of the limb involved, the injury seemed likely to be attended by serious results ; but, under the simple local treatment of poultices and fomentations, and the exhibition of opium in combination with antimony to allay the febrile action, he recovered with scarcely a bad symptom. The free openings allowing the sloughs of fascia to be readily discharged, the wound suppurated and healed kindly.

Case II.—John Hughes, æt. 27 ; postman ; residing at Winchburgh.

History.—On the night of the 7th of January 1868, he was holding a gun-barrel, which was loaded, in his left hand ; and accidentally allowing the barrel to fall to the ground, the nipple thereby came in contact with a stone or pebble, the gun-barrel went off, and he received the contents in his left arm. A very slight amount of bleeding took place, which he arrested by means of cold water and linen rags moistened with it.

On the following morning patient presented himself at the Royal Infirmary, and was admitted to ward 18, surgical.

Examination on Admission.—The contents of the barrel had entered the left arm, just over the internal condyle of humerus, and then travelled beneath the skin and through the fascia to the outside of the arm, going upwards, backwards, and outwards, round the arm to that part of the outer

side nearly one inch above the middle of humerus, and lodging more posteriorly than anteriorly.

The fascia and skin of the inner side for two to three square inches over the internal condyle were torn, the common origin of the pronator radii teres, and other muscles of the forearm, was visible, but apparently uninjured ; a few of the fibres of the brachialis anticus were lacerated. The ulnar nerve was almost bare, and near the centre of the wound the nerve was much narrower than either above or below. The brachial artery was found to be entire and uninjured.

Examination continued.—The ulnar nerve was found to be quite sensitive where constricted, but both above and below it had lost its sensibility to touch.

For the purpose of this examination the wound was enlarged.

The skin opposite the point where the contents lodged was blue-looking and bulged out.

Treatment.—An incision was made over the enlodged pellets, and a large number of Nos. 4 and 5 shot, also a few *swan* shot and some wadding, were extracted.

The tract was cleaned out as well as it was possible to do by syringing.

Progress of the Case. *Jan.* 12.—Patient feels very feverish and chilly ; a purgative ordered.

Jan. 17.—Patient's general health much better to-day. The nerve sloughed, and Professor Spence removed a portion of the nerve on each side of the sloughed part. Wound emitting a quantity of grey-coloured pus. Cataplasma carbon applied.

Jan. 19.—Wound is assuming a healthy action.

Jan. 21.—Continuing better ; sulphate of copper applied.

Jan. 27.—Margins of wounds brought closer together by strapping. Patient doing very well.

Jan. 30.—Patient rose from his bed, and there was found on pinching to be a slight amount of sensibility in little finger.

Feb. 11.—The wounds healed favourably, and to-day patient was dismissed, retaining a little sensitiveness in his little finger.

Nov. 1.—Patient states that he has entirely regained the use of his arm ; can perceive any one pinching his little finger as readily as if any of the other fingers were pinched.

Case III.—A. T., a strong healthy man, æt. 22. Admitted May 2, 1859.

On the 30th April 1859, a gun which the patient was carrying went off accidentally, lodging the contents (Nos. 4 and 5 shot, and paper wadding) and part of his clothes in the left forearm.

The charge entered about four inches below the elbow joint, on the ulnar edge, anterior to the bone, making a large ragged wound, and several smaller ones, blackening the skin. Passing across the arm, part of the charge came out three inches below the elbow, on the radial side, anterior to the bone, giving rise to several small pellet wounds situated on the summit of a projecting portion of skin.

On admission, the limb from the forearm to the middle of the upper arm was much swollen and erythematous, with discharge of pus from the exit wound, which had the appearance as if the charge were lodged below the skin. Neither the radial nor ulnar pulse were perceptible at the wrist.

Mr. Spence placed him under chloroform, and after enlarging both wound , removed from that of exit 20 or 30 pellets, a quantity of burnt paper, and some sloughy textures. The muscles and other tissues were much torn by

the shot; and although the radial artery could not be felt in the wound, which lay right across its course, the temperature of the hand was moderate.

Warm fomentations were applied to the wounds and erythematous parts, and cotton wadding to the hand. Ordered a large opiate, and thereafter small doses of antimony and morphia every three hours.

Vespere.—Pulse 134, weak; feels his arm easier.

May 3.—Upper arm more swollen, but less erythematous; pulse 100; tongue furred, but moist. Feels more comfortable.

May 4.—An incision was made over upper part of forearm to relieve tension. Swelling and erythema less; pulse 100, soft; patient does not complain of thirst or pain.

May 6.—Erythema and tension considerably decreased. Pulse 92, fuller; wound granulating favourably.

May 13.—A bandage from hand to the middle of the arm was applied to-day, to obviate a tendency to œdema about wrist and forearm. Patient's general health good. The wound cicatrising.

Remarks.—In these cases we have examples of the extensive laceration and destruction of textures in the course of the charge, as compared with the smooth track of a ball; at the same time, I believe that the favourable progress of the wound in Case I. may have been in some measure due to the complete destruction of the fascia preventing tension occurring, and the shreds of the sloughing membrane and muscle being readily discharged by the large aperture of exit. The treatment at first adopted illustrates in it, I think, the necessity of drawing attention to the nature of such cases. Case II. is specially of interest, on account of the destruction of the ulnar nerve, and the subsequent restoration of motor and sensory power in the parts supplied by it. Such a result can scarcely be expected generally in such cases, and possibly was due to some nervous connections with the median above the injury in this case; but it shows us the propriety of trusting to nature in cases of division of important nerves, and not where the question of amputation has to be considered. Case III. (*T.'s Case*).—This case is illustrative of the effects of a charge of small shot entering *en masse*, then expanding and scattering in the tissues; and it shows how much we may venture in a person of good constitution, when no bone or joint has been injured. In this case, when I had dilated the wounds, I felt all the soft parts between the two wounds as if torn to shreds—in fact, a mass of torn muscle and clots, mixed with small shot and bits of torn wadding and cloth; and yet little or no sloughing took place, showing that the parts were more torn or cut than contused.

It is difficult to conceive how the great vessels could have escaped, for the wound was close to the point of bifurcation of the brachial, and I could feel no vessel beating in the wound, nor could I perceive the pulse at the wrist; still no secondary bleeding occurred, nor was the hand very long of regaining its natural temperature and feeling. Altogether the result was most satisfactory; and even as regards the destruction of the muscular tissues, I have since heard from Dr. Black of Cockburnspath, who sent the patient to my care, that the man has now so completely recovered the use of the arm as to be able to engage in the hard work of the herring-fishery.

Case IV.—A. C., æt. 17. The lad was carrying a gun in his pocket, the barrel in one, and the stock in the other pocket, when the barrel fell out, exploded, discharged its contents and drove part of the wooden stock into his left axilla. Mr. Spence removed a great quantity of the charge, comprising splinters, wadding, shot, etc., and enlarged the wound so as to give free access to the remainder to come away with the sloughs. The axillary artery was found to be uninjured, but a small part of the subscapular fossa was felt bare. Poultices were applied, and the wound progressed favourably for some days. Nine days after admission bleeding came on after dressing, but on examination and enlargement of the wound this was found only to proceed from a small artery, and was stopped with little trouble. The following day bleeding again took place, but was arrested on the application of ice. From this time feverish symptoms set in ; and in a few days, chest symptoms showing themselves, Dr. Rhind examined and found hypostatic congestion of the lungs. Poultices were applied, but acute pleurisy supervening the patient rapidly sank. I have referred to this case in my Lecture as one of those exemplifying the increased danger arising from even an apparently trivial injury of bone in gunshot cases.

The next case, whilst it illustrates a wound of the soft parts inflicted by raking shot, has special points of interest in other respects. I shall, therefore, detail the facts of the case from the Hospital Journal, before commenting on it as exemplifying the serious complications we may meet with in such wounds.

Case V.—John D., æt. 34, residing at Newlands. Admitted 17th October 1857.

From the rambling statement of the patient, whose intellectual faculties seem in some degree impaired, it would appear that, when out poaching on the night previous to his admission into the hospital, he engaged in a quarrel with another poacher. A struggle between them ensued, during which one of the guns went off close to the patient's left side. He was brought to the hospital on the morning of the following day. On examination, it was found that a large portion of integument on the lower and inner side of the arm, immediately above the elbow, had been carried away by the contents of the gun. The tendon and part of the muscular tissue of the triceps were torn off, while parts of the brachialis anticus and biceps muscles were laid bare. A large portion of the ulnar nerve was wanting. The median was exposed for about an inch, and close beside it the large brachial trunk was seen to pulsate, apparently, however, uninjured ; but one of the venæ comites was wounded. There was great laceration of the skin and deeper-seated textures, but the bone was untouched. It was decided that amputation was not imperatively called for, and that, with rest and proper treatment, a useful limb might be saved.

Oct. 18.—Patient feels very little pain from the arm. Wound looking slightly sloughy. Pulse 106.

Oct. 23.—Wound sloughy. Tongue coated. Pulse 124.

Vespere.—Hæmorrhage occurred from the wound about 5.45 p.m., but was immediately arrested. Mr. Spence was sent for ; and, finding that the bleeding proceeded from the brachial artery, he cleared the vessel and tied it above and below the opening. Very little blood was lost.

11 p.m.—Temperature of the hand and forearm equal to that of the opposite arm. Faint pulse at the wrist.

Oct. 24.—At a consultation to-day, Mr. Spence's opinion (that no interference was at present required) was agreed to.

Oct. 25.—Radial artery at wrist quite perceptible. Pulse 120.

Oct. 26.—Pulse 130. Considerable sloughing taking place at lower and inner part of wound, but quite healthy near the artery.

Oct. 29.—Greater part of slough separated. Wound looking clean. Pulse 132.

Nov. 3.—Going on well. Pulse has gradually come down to 102. Ordered ℥iij. of port wine.

Nov. 10.—Still improving. Pulse 96. Ordered ammonio-citrate of iron.

Nov. 16.—Wound dressed with red lotion, and gentle support given with a flannel bandage. Allowed to rise.

Nov. 23.—This morning the back of the little and ring fingers of left hand are covered with large blisters. (The weather is intensely cold.)

Nov. 28.—Small sloughs have separated from the fingers.

Dec. 19.—Wound of arm contracted to about the size of a shilling. The little finger is now quite well; other fingers nearly so.

Dec. 24.—Both fingers now well.

Dec. 26.—There is a vesication as large as a fourpenny-piece on the ring finger, and another of the same size on the point of the little finger.

Jan. 3, 1858.—Patient having gone on steadily improving, was allowed to leave to-day.

Remarks on the Case of John D.—There are several points of great practical interest in this case. I would specially invite attention to three.

1. The condition of the wounded limb when first seen, and the considerations which led me to decide on conservative measures.

2. The occurrence of secondary hæmorrhage from the brachial artery, and the question of practice under the peculiar condition of the arm.

3. The local effects of the destruction of the ulnar nerve, as shown in the impaired vitality and liability to sloughing of the fingers supplied by it, as compared with the rest of the hand.

The circumstances to be considered regarding the treatment of this case, in the first instance, were not, how far the state of the injured limb admitted of its being saved, but whether there was a probability of the limb, when healed, being useful, so as to counterbalance the risks which the patient must run in the attempt to save it. On the one hand, there was the large lacerated and contused wound, the integuments torn off extensively, and a portion of them absolutely blown away; a very considerable portion of the triceps and brachialis muscles destroyed; about three-fourths of an inch of the ulnar nerve shot away, together with the inferior profunda artery and anastomotica magna both wounded; the great median nerve exposed so as likely to be involved in the cicatrix; and the brachial artery exposed for about half-an-inch, the sheath being torn and one of the venæ comites wounded. When the probable further loss of substance from sloughing and the chance of secondary bleeding were taken into account, the risks to be run were considerable, and the probable usefulness of the limb might seem doubtful. On the other hand, there was no injury of the bone or joint; the integuments separated were more lacerated

than contused, and their vitality seemed little impaired; the actual loss was not very large; and as a considerable portion of muscle had been shot away, there would be less substance to cover in, and consequently less contraction after healing—a calculation which I had often verified in other cases, and hence I had not much fear of a contracted limb. The lesion of the ulnar nerve was serious, but not necessarily destructive to the use of the hand. The median nerve, though exposed, was intact; and the main artery, though laid bare, might not be so injured as to give rise to secondary bleeding; and therefore I considered myself fully justified in attempting to save the limb, more especially as, from the great loss of blood the patient had sustained from the wounded veins and smaller arteries, he was rendered little able to undergo any operation not absolutely imperative.

The second, and I think the most interesting, stage of this case was, when the surface of this extensive wound being in a sloughy condition, secondary hæmorrhage from ulceration of the brachial artery took place, still further complicating the case. On being summoned to see the patient, I found a small clot of blood over the part corresponding to the site where the artery had been exposed, and this clot moving with each pulsation of the vessel. But, recollecting that one of the venæ comites had been wounded, and that possibly the easily-arrested bleeding might have been venous, I caused Dr. Yellowlees to compress the brachial at the upper part of the arm, and then, having brushed away the clot, I desired him to relax his compression, when the full jet of arterial blood at once dispelled all doubt as to the nature and source of the bleeding. I then dissected along the course of the vessel, so as to clear it at a healthy point not too far removed from the opening. As the parts were matted and sloughy, and the vessel flaccid from being compressed above, some difficulty might have been experienced in recognising and clearing it, especially on the distal side of the opening, but for the simple and old-fashioned expedient of gently introducing a common probe through the opening into the canal of the artery, so as to render it perfectly distinct and easily cleared and secured.

The occurrence of secondary hæmorrhage from a large arterial trunk implicated in an incised wound, however matted the surrounding parts may be by inflammatory action and previous attempts at compression, would scarcely induce any surgeon in the present day to think of amputation. But here the case was more complicated; for not only was the original wound such as rendered the prospect of saving a useful limb somewhat problematical, but I knew positively that two of the most important collateral branches—viz. the inferior profunda and anastomotica magna—were destroyed; and hence the anastomoses, on which we depend for carrying on the circulation to the parts beyond the ligature, seriously interfered with. I confess that at first I merely looked to the ligature as a temporary measure to save immediate loss of blood, and allow the patient time to rally before amputating; and as the case was likely to be a medico-legal one, I directed a consultation to be called for the next morning. However, on my visit late at night, I was agreeably surprised to find the hand of a good temperature, and a distinct, though feeble, pulse in the radial artery of the injured limb.

Next morning the pulse was quite distinct, and the condition of the limb, as regarded the fully re-established circulation, such as left little room for difference of opinion as to persevering in conservative treatment.

I think that there could scarcely be any case which better illustrates how much we may trust to vascular supply, even after many of the larger anastomoses are cut off. And when we consider the sloughy state of the wound, impaired nervous supply from division of the ulnar nerve, and swelling from exudation, which, to a certain extent, would press upon and obstruct the smaller vessels, together with the debility of the patient from the great loss of blood at the time of the accident, no case could well appear less favourable as regards the prognosis.

I have dwelt so long on this case, that I shall merely notice the third point alluded to—the sloughing of parts of the ring and little fingers—as corroborating what there are now so many examples of, viz. the impaired vitality, and consequent tendency to chronic gangrene or sloughing, in parts whose nervous energy has been destroyed or diminished. In this it forms a good contrast to the result in the case of John H. (Case II.)

In conclusion, the state of the limb when the patient left the hospital was such as fully to verify my original hopes; and looking at the small cicatrix, the absence of contraction, and the free movements of the elbow and forearm, those who had not seen the wound at first would hardly have believed such an extensive injury had existed.

Case VI.—*Wound of Elbow-Joint.*

James H., æt. 16, shop-boy, Dalkeith. Admitted April 1, 1856.

The patient states that, being out in the fields, he was carelessly leaning on the muzzle of a loaded gun, when by accident something caught the trigger, and the contents of the gun were discharged *en masse* into the inner side of the arm. He was admitted to the Royal Infirmary five hours after the accident. The aperture of entrance over the inner condyle of the humerus was about the diameter of a musket-ball; on the outer side the aperture of exit was a ragged wound, extending for about two inches above the elbow-joint to an inch and a half below it. As the bones were felt to be shattered and the joint opened into, it was evident that amputation was the only resource. Accordingly it was performed at the lower part of the upper third of the humerus.

Case VII.—*Amputation of Hand for Wound of Wrist.*

The following case, which happened to a medical friend and former pupil, affords another example of this class of wounds. It is partly reported by the patient.

"As to the accident which cost me my right hand.—On the 16th of August 1866 I was loading a central fire breech-loading cartridge, when it exploded, owing, I think, to the cap not being home on the anvil and my loading it on a flat surface. The machine I used was a large cylinder to go outside the cartridge, containing a smaller one to go inside to ram down the charge. I had put in $1\frac{1}{4}$ oz. of shot (No. 5), and was ramming this down when it exploded, and, of course, the cylinder acted like a pistol barrel;

otherwise the charge would have scattered, but it entered the palm of my hand opposite the third metacarpal bone like a bullet, making but a small wound, shattering all the bones, and passing upwards, and lodging in my wrist. The hand was considerably swollen. There was, however, so little appearance of extensive damage that Dr. C—— of Auchterarder gave his opinion that it would not be necessary to amputate. In consequence of this opinion amputation was not performed for twenty-four hours after the accident, when symptoms of inflammatory tension had shown themselves."

I amputated in the forearm, and all went on well for ten days, when I was sent for in consequence of smart secondary hæmorrhage. On opening up the stump, I could find no bleeding point. All the large vessels were secure. The clots were removed, and, after an hour, I closed the wound, from which there was no further bleeding. Mr. W. made a good recovery, which was only retarded by an attack of suppurating sore throat.

On examination of the wounded hand I found the shot had spread, tearing up the tendons, nerves, and vessels of the palm, and injuring the carpus severely, but without displacing the injured bones; so that externally the parts presented little appearance of the gravity of the injury inflicted.

Remarks.—These cases exhibit the terribly destructive effects of a penetrating charge of small shot striking the articular extremity of a bone, as compared with a wound of the same parts with ball. In bullet wounds of the cancellated texture of the articular ends of bones, such as the humerus, the ball may lodge or simply perforate; and, unless the shaft be struck directly, it is comparatively rare to find it much comminuted, whilst the wound of the soft parts is generally a smooth perforation; hence, of late, primary excision of the elbow-joint and of the head of the humerus in such wounds, as a conservative measure, has been extensively practised with very great success; at once removing the injured articular structures, and saving a useful limb with a movable joint. But in cases of injury like those narrated, which are examples of the kind generally met with in civil practice, we see how futile would be any attempts at conservative practice, either by excision or otherwise; for, from the mass of shot striking the end of the bone, it is extensively shattered, the comminution extending far up into the shaft; and not only so, but as the charge expands, all the surrounding textures are torn and burst up, as it were, so that, even as regards the soft parts, the injury is so completely destructive as to leave no alternative but amputation.

Whilst the foregoing cases show how seldom it is in our power to perform excision in cases of joints injured by small shot, the following case of gunshot wound of the shoulder shows that the nature of the injury may be so modified as to enable us to do so with success.

CASE VIII.—*Primary Excision in Gunshot Wound of Shoulder.*

——, aged fourteen, whilst out shooting on the morning of the 28th August 1872, and carrying his fowling-piece at a trail, something caught the trigger, and the contents of one barrel were discharged, causing a severe injury of the shoulder.

The accident happened about 8 A.M. In the afternoon I was telegraphed for, and reached Madderty, Perthshire, where he resided, about 9 P.M.

On examination I found a contused and lacerated wound corresponding to the anterior aspect of the deltoid muscle, the fibres of which were extensively torn in the line of wound ; the point of the acromion process was fractured and turned back. The tuberosities of the humerus were seen and felt to be shattered, and the capsule of the shoulder-joint opened, but, so far as I could feel, the shaft of the humerus was uninjured. I accordingly determined to try and save the arm by excising the head of the humerus and tuberosities in the first instance. I accordingly did so by including the injured muscle and skin between two converging incisions, so as to leave healthy structures to unite. This wound enabled me readily to disarticulate the head of the humerus and resect it below the tuberosities, a little below the surgical neck of the bone, where it was quite sound ; and I also removed the fractured and almost detached portion of the acromion, and smoothed the surface with the bone-pliers. A few vessels were secured, and the wound thoroughly cleansed by pouring warm water over the surface. The margins of the wound were then united by silver sutures, and the result was a single linear incision.

Before leaving in the morning there was considerable tension, and I removed some of the sutures.

I did not see him again until he visited me in Edinburgh. The after-treatment was conducted by Dr. James Gairdner, Crieff, and consisted in dressing the wound with carbolic lotion, and occasionally with diluted Condy's fluid. The dressings consisted of lint and oakum, and supporting the arm in a sling. The use of passive motion was begun in about a fortnight. The patient made a good though somewhat slow recovery. He now resides in Edinburgh, and I have seen him lately ; he has great use of the arm for all ordinary purposes.

Remarks.—This case contrasts with the preceding one of gunshot injury of the elbow, and shows that even in small-shot injuries we may occasionally be able to save the limb by primary excision, but it is the only case of gunshot injury of the shoulder in which I have been able to do so. It is evident that the shot struck obliquely as a raking shot, throwing aside the skin, tearing the muscle, and then partially lodging in and shattering the head and tuberosities of the humerus. In this way there was less destruction of vitality of the soft parts, and no shattering or longitudinal fissure of the bone such as we usually find in these gunshot injuries.

Class II.—Injuries inflicted by Wadding or Paper Pellets.*

The second class of injuries, those resulting from the discharge of firearms loaded with powder and wadding only, or with paper pellets, closely resemble bullet wounds in their general character, though, of course, much less destructive when fired from any great distance. They require some attention, however, for two reasons :—First, because I think the dangers from such projectiles is much underrated ; and secondly, because of the greater difficulty of recognising the presence of the foreign body when lodged deeply in a wound, and so the chance of leaving a part or the whole of the charge in the wound.

* These are made by chewing the paper to a pulp, then pressing it, rolling it up hard into the form of a bullet, and drying it slowly, so that it forms a hard compact mass.

I have said, first, that the dangers of wounds by wadding are much underrated. People speak slightingly of wounds from "a boy's pistol," or "a child's cannon loaded merely with powder and wadding;" whilst the boys, those demonstratively loyal subjects of her Majesty, apparently have a most unlimited faith as to the safety of paper in any form, though every anniversary of her Majesty's birthday might teach them the contrary. I have selected only one or two instances of these wounds, to show not only how serious such injuries sometimes are, but that even as mere flesh wounds they are attended with considerable risk. Indeed, it is only a few months ago since a man was killed from the folly of two lads, who, attracted by some peculiarity of his hat, thought they might safely blow it off with a pistol charged with wadding; whereas they not only blew off the hat, but also a considerable portion of the unfortunate man's skull.

The second point is the difficulty of ascertaining the presence of the foreign body, or, as I should perhaps rather express it, the liability to be deceived as to the whole charge being extracted. Even at the first it is obvious that, from the nature of the substances as compared with a metallic body, the diagnosis by means of the probe must be much less decided; and after the mass of paper or pellets has been partially softened by imbibing the blood and discharge, the diagnosis becomes still more difficult, as the sensation conveyed by touching the foreign body with the probe is exactly similar to that of the textures of the wound; and therefore, unless prepared for this, we are very apt to suppose that all the charge has been extracted, whilst in reality several pellets may remain, and only be discharged as the sloughing and suppuration enlarge the track of the wound. This is well exemplified in the following case, which is also a good example of a simple flesh wound inflicted by wadding or paper pellets.—

Case IX.—*Flesh Wound of Arm.*

Andrew Crosson, æt. 11. Admitted May 21.

The patient was standing before a small cannon, when it accidentally exploded, and lodged the contents, together with a portion of his jacket, in the middle of his arm. On his admission, the small piece of the jacket and a bullet of paper were removed. Ordered poultices for a short time, to be followed by warm-water dressing.

May 22.—Slightly feverish. Ordered a purgative, followed by an anodyne diaphoretic mixture.

A considerable amount of inflammatory swelling and sloughing of the wound ensued. Some sloughs separated, and suppuration followed.

May 24.—A paper pellet was seen in the wound and extracted.

May 25.—Another paper pellet came away this morning.

May 28.—The slough had completely separated from the edges and track of the wound, and the general appearance of the wound was healthy. Warm-water dressing.

June 4.—Discharged cured.

Remarks on Crosson's Case.—In this case, when the piece of the jacket, a considerable piece of wadding, and a large hard pellet of

paper, were extracted, I felt satisfied, and was somewhat surprised at finding other pellets when sloughing and suppuration had enlarged the wound. But whilst this is worthy of attention, as it is obviously of great advantage to extract at once and completely the whole of the charge lodged in the wound, so as to remove a very evident source of irritation, it would be wrong to suppose that, but for the presence of the foreign body, the tract of such a wound would heal kindly without diffuse inflammation and sloughing. The wound, it must be recollected, is one inflicted by an obtuse body impelled with great force. The vitality of the textures immediately acted on by its passage is destroyed at once, and *these* must therefore slough and be thrown off by the process consequent on the reaction of the textures immediately beyond; and therefore, even if all the foreign bodies be extracted, the progress of such a wound is always attended with considerable local and constitutional disturbance.

A few days after the occurrence of the case narrated, a young lady was brought to my house who had been shot through the arm whilst witnessing a review. The wound was very nearly in the same position as the boy Crosson's, and presented the same appearance. I examined it with a pair of long narrow polypus forceps, and at once readily extracted the whole of the case of blank cartridge which had been lodged, yet the general progress of the wound was very much the same as in Crosson's case; showing the immediate destruction of the vitality of the textures by the forcible contact of the passing charge.

The next case exemplifies the destructive effects of a charge of powder and paper wadding only, fired close to the part wounded, necessitating primary amputation of the injured part.

Case X.—*Lacerated Wound of Hand, with Comminuted Fracture of Bones and Wound of Joint.*

John H., æt. 14, blacksmith. Admitted 14th May 1856.

Upon admission, the patient was found to have sustained a severe injury of the hand, from the accidental discharge of a small cannon which he was cleaning. The ulnar side of the hand was entirely destroyed, including the carpal and metacarpal bones on that side, about half-an-inch of the lower part of the ulna was broken off, and the ulnar artery and nerve were torn through opposite the wrist-joint. On the palmar surface of the hand there was a deep gash, dividing all the tendons and laying bare all the bones. Amputation was performed at the forearm in the usual manner, and the patient was discharged cured in little more than a month.

Class III.—Injuries from the Bursting of Firearms.

The injuries of the third class, viz. those caused by the bursting of firearms, affecting most frequently the hand and forearm, very generally necessitate primary amputation; but this necessity arises rather from the nature of the parts injured than from the intrinsic dangers of the kind of wound inflicted. If, indeed, the injury be caused by the breech of the gun striking the part directly, the

destructive nature of the wound will be very great; but if, as is most generally the case, the injury be inflicted by the sharp fragments of the barrel of the piece, the soft parts are rather cut than contused, and though, from the parts being scorched and blackened by the explosion, the wound presents a frightful appearance, the vitality of the skin and soft parts is not in general much impaired. This is evidenced by what we see in cases where only the soft parts are torn extensively, and where, with the exception of the aponeurotic and fascial textures, little or no sloughing occurs, such wounds often healing with very trifling contraction. It is well to keep this in mind in deciding on the question of complete or partial amputation of the hand under such circumstances, as the decision sometimes turns on the question, How far can we calculate on having a sufficiency of healthy soft textures left to cover in the parts, without undue contraction? and so, What are the probabilities of saving a useful limb?

The following cases illustrate this principle.

Case XI.—J. M., æt. 15.

The patient was brought to my house on a Saturday evening, on account of an injury sustained by the bursting of a fowling-piece. He stated that, whilst walking with some companions near Granton, they fell in with some other boys who had a fowling-piece, which they said was rather heavily loaded, and that they would like some one to fire it off for them. With this cool request my patient at once complied, when the gun burst and was shattered to pieces, wounding his hand severely.

Notwithstanding the pain and bleeding, he tied up his hand with a handkerchief and walked to town. On reaching my house, he was very pale and his pulse weak; but, after giving him a little wine and water, I proceeded to examine the hand, when I was rather shocked at the appearance it presented. The centre of the hand seemed entirely destroyed, the thumb hung loose with a flap of skin and muscle detached from the palm, and the whole hand was blackened and scorched. On washing the part and examining more fully, I found that the carpal articulation of the thumb was safe, as also the carpo-metacarpal articulations generally, the metacarpal bones of the fore, middle, and ring fingers being shattered immediately below the articulation. After tying some vessels which were bleeding, I sent him to his home, which was in the neighbourhood, and explained to his father the necessity for partial amputation.

From the appearance of the flaps detached from the palm and continuing attached to the thumb and little finger, they seemed more cut than bruised, and as the dorsal aspect of the hand was little injured, I determined to attempt to save the thumb and little finger. I therefore dissected out the three injured fingers, smoothing off the attached ends of the metacarpal bones, and removing all the lacerated tendons and portions of muscles. A very large number of vessels required ligature, which I looked on as a hopeful circumstance, evidencing the vitality of the parts. The thumb and little fingers were then approximated, and retained by two or three stitches, and the wound dressed with lint soaked in warm water and kept constantly moist. The wound suppurated kindly. No sloughing of the skin occurred, and the boy made a good recovery, retaining a very useful though somewhat odd-looking hand.

Case XII.—Robert Jack, æt. 32, was admitted into the Royal Infirmary,

on Sunday, 5th December last, on account of an injury of the hand, received late on the previous night, in consequence of the bursting of his fowling-piece.

On examining the hand, I found the thumb loose, the muscles connecting it with the palm being torn from their palmar attachment; the joint between the metacarpal bone and the trapezium was slightly opened; the wound of the integuments was V-shaped, and as cleanly and accurately made as if done by the surgeon's knife for the oval amputation of the thumb (plate ix. fig. 5, p. 216). On further examination, I found the fourth metacarpal bone fractured by the force of the concussion; but the palmar wound did not communicate with the fracture, and there seemed no lesion of the carpal articulations. I therefore disarticulated the thumb at its junction with the trapezium, and removed all the torn and bruised muscles. The radial artery, where it forms the deep arch, and its branches to the index finger, were then tied, two points of suture were inserted at the angles of the wound, leaving the greater part of it open to favour the escape of matter from the deep part of the palm, and tepid-water dressing was applied. The patient suffered a good deal at first from pain in the course of the ulnar nerve, but this gradually subsided under the use of opiates. On the fifth night secondary hæmorrhage occurred whilst he was asleep, and he lost a considerable quantity of blood; it had ceased spontaneously before the resident surgeon saw him; it recurred three or four nights afterwards, and on this occasion he controlled it by compressing the brachial till the resident surgeon came. On examination, it was found to arise from a small branch under the skin, which was tied, and no further bleeding took place. With this exception, he never had a bad symptom; and he was dismissed on the 3d of January, the wound nearly whole: not the least portion of the skin divided by the fragments of the gun has sloughed, and the cicatrix of the wound is as regular as that resulting from amputation of the thumb.

These cases are examples of an injury of a very severe kind, in which, however, from the knowledge that the wound of the soft parts is not so destructive of their vitality as the formidable appearance might lead us to expect, we are enabled, by means of partial amputation, to save a useful member. But our warrant for this practice depends on the absence of any lesion of the carpal or radiocarpal articulations; for if either of these be injured, or the flexor tendons and great palmar nerves and vessels torn extensively, amputation of the forearm is the proper practice, and, accordingly, we have occasionally to deal with cases where the appearances indicate less injury than what really exists. As an instance of this, I may refer to a case lately under my care in the Infirmary.

Case XIII.— — S., admitted 20th October 1858.

The patient, whilst shooting, had his left hand injured by the gun bursting. The medical man who first saw him amputated the ring finger and the distal phalanx of the middle finger, which were shattered, and removed the thumb, which was merely hanging by a bit of skin, and, after securing the bleeding vessels, sent him to the hospital. On seeing the patient, the remains of the hand did not look very bad, but there was great pain over the carpus, and crepitus could be felt in that region on moving the middle finger. I explained to the man that we might try to save the remains of the hand, but there would be some risk, and I thought it probable we might not succeed in the attempt. He said he wanted the hand amputated at once, as he was sure

the part left would be worse than useless. As this accorded with my own opinion, I complied, and performed amputation at the middle of the forearm. On examining the hand, I found, on opening out the sutures where the thumb had been removed, that the wound had penetrated obliquely towards the centre of the palm, wounding the deep arterial arch, and opening the carpo-metacarpal articulation ; the unciform bone was shattered, and there was great effusion of blood amongst the textures.

This case shows the necessity of carefully examining the wounds, and opening out any sutures which may have been inserted to close them, so as to make sure of their exact direction and judge as to the safety of the carpal joints ; for I feel confident that if attempts had been made to save this hand, diffuse inflammation of the forearm and along the sheath of the tendons, with acute ulceration and suppuration of the carpal articulations, would certainly have ensued, and the constitutional disturbance would have ultimately forced me to amputate, under less favourable circumstances. In cases where the thumb can be saved, retaining its free movements, I always prefer running considerable risk rather than amputate ; but when, as I have more generally seen in this form of accident, the thumb and outer part of the hand are blown off, and we can at the most only save the two inner fingers, if we take into account the risks incurred to save a portion of the hand often worse than useless, I have no hesitation in stating, from my experience of the result of such cases, that, as a general rule, primary amputation of the forearm is the safer practice.

ANTISEPTIC TREATMENT.

In my Lectures on Wounds I have stated the treatment I usually adopt, and my reasons for preferring the simple to more complicated dressings. I have therefore thought it better that the reader should have an opportunity of studying the special "Antiseptic Method," as described by an advocate of the system. The following is, by kind permission of the author, Dr. Bishop, taken from Swain's *Manual of Surgical Emergencies*:—

"Pure carbolic acid—remarkable for its power of destroying low forms of life—is, on the whole, the most efficient antiseptic for general purposes. Its energetic action on the epidermis makes it the best agent for cleansing purposes. In the form of one to twenty watery solution it is used for purifying the integument of the part to be operated upon, and the sponges, instruments, etc. As a one to forty solution it is used for washing sponges during an operation, for the hands of the operator and assistants, and for the changing of dressings.

"The volatility of carbolic acid renders it invaluable for dressing hollow wounds and abscesses. It is the active constituent of the ordinary dressing—antiseptic gauze—which is applied, in eight layers, of size proportioned to the expected amount of discharge. A piece of thin mackintosh cloth (technically called hat lining) is interposed beneath the outer (eighth) layer of gauze to prevent the discharge from soaking directly through the centre of the dressing, washing out the portion of acid there stored up, and thus giving putrefactive organisms direct access to the cavity. Further, as carbolic

acid is given off very slowly by the gauze at the ordinary temperature of the air, it is quite possible that septic organisms, accidentally adherent, might be conveyed to the wound by the surface of the dressing itself. To guard against this mishap, that portion of the inner layer of gauze which will lie opposite to the wound is damped with the promptly acting one to forty solution, or else a small portion of gauze wrung out of the same solution is applied before the ordinary eightfold dressing. The antiseptic gauze is convenient in the form of bandage, which not only applies itself, and retains its position better than a calico bandage, but is often a valuable addition to the antiseptic quality of the dressing. In the case of stumps in which there is a tendency to retraction of the soft parts, the antiseptic bandage enables the surgeon to overcome what would otherwise be a considerable difficulty in the treatment of the case.

"It is not sufficient to have a reliable dressing, and to be able to purify the skin and the instruments employed. There must also be an antiseptic state of the atmosphere, which cannot fail to gain access to the wound, or abscess, during the operation, or changing of dressings. This is provided in the form of a spray of one to forty carbolic acid solution. . . . . .

"When the spray is suspended during an operation, or the changing of a dressing, the wound should be covered with a piece of sound calico, moistened with one to forty carbolic solution, which for convenience is termed the guard ; of course neither spray nor guard is required for superficial sores.

"Boracic acid is a powerful antiseptic, but its non-volatility prevents its being used for the dressing of hollow wounds, and for the spray. It is bland and unirritating as compared with carbolic acid, and is therefore particularly useful as a dressing in all superficial wounds and sores. It is employed in the form of a saturated watery solution, and as boracic lint, which contains about half its weight of the crystals of boracic acid. The mode of using these preparations is given in the sequel. . . . . . .

"In order to obtain the best results from the antiseptic treatment, it is desirable to protect the healing parts from the irritating influence of the antiseptic itself, which in the case of carbolic acid would often prevent cicatrisation altogether, and which even with the much blander boracic acid is better avoided. This is done by interposing a protective layer, consisting of some material unirritating in itself, and as far as possible impervious to the antiseptic agent.

"The protective commonly used is composed of thin oil-silk, varnished with copal, and then coated with a layer of dextrine. The dextrine allows the oil-silk to become uniformly wetted by the antiseptic solution, into which it is dipped at the moment of application. It is obvious that the antiseptic dressing proper must extend a considerable distance beyond the protective, or putrefaction may spread under the latter, in spite of the dressing which is above it.

"The application of antiseptics to the raw surfaces of a wound causes a certain amount of irritation, and leads to an unusually abundant discharge of serum ; so, in order that this may not be pent up, and occasion inflammation from tension, a very free outlet must be provided. This is effected by means of Chassaignac's drainage tubing . . . . Large holes are cut in the walls, so as to allow the discharge to reach the lumen of the tubes ; and two loops of silk thread, knotted at the ends, are attached to opposite sides of the margin of the outer extremity of the tube to prevent displacement. The outer end is to be cut either transversely or obliquely, according to the direction of the cavity, so that the orifice of the tube may be flush with the integument.

"When abscesses are opened, a drainage tube should be used, of a length

equal to the depth of the cavity, and of a calibre proportioned to the quantity and thickness of the pus discharged. The tube should be shortened from time to time as the cavity becomes smaller.

"For arresting arterial hæmorrhage the prepared catgut used antiseptically is employed.

"As metallic sutures are liable to catch in the dressings, carbolised silk sutures are used with advantage. . . . .

"Directions for Special Cases.

"I. *Abscess.*

"This is the simplest case for antiseptic treatment, the antiseptic not being applied at all to the affected tissues, but merely used to prevent the access of septic mischief from without.

"Carefully select the spot for incision with special attention to its distance from a source of putrefaction, so that the dressing may extend freely beyond the incision in every direction. The skin, the knife, and the operator's fingers having been cleansed with one to twenty carbolic solution, after shaving off hairs from the integument if necessary, let the spray play effectively on the part, then make an incision in the selected position, and of such a size as will easily admit the drainage tube; press out the pus, insert the drainage tube, and extend the loops of silk in opposite directions; apply over the incision a small bit of gauze wetted with carbolic solution, cover this with a large dressing, consisting of eight folds of gauze and the enclosed piece of mackintosh, as above described; and, lastly, secure this with a well-adjusted gauze bandage, and with safety-pins, which must not penetrate the centre of the mackintosh, or its efficiency will be destroyed. If it is desirable to explore the abscess cavity with the finger, special care must be taken that the latter be well cleansed about the nail and elsewhere with the solution immediately before introduction.

"Next day let a hand be placed so as to keep the dressing in position whilst the pins are being removed and the bandage is being cut. Direct the spray towards one side of the dressing, which must then be cautiously raised, so that the spray may pass into the angle between the dressing and the skin. Remove the drainage tube under the spray; cover the incision with a guard; wash the drainage tube and the skin with one to forty solution; again direct the spray to the incision, remove the guard, insert the tube, and dress as above described.

"As the discharge diminishes dress the case every two, three, four, five, or six days as required. Give the same amount of care to every dressing until cicatrisation is complete; this being the only trustworthy evidence that the sinus is closed. In cases of chronic abscess due to caries of vertebræ or to morbus coxæ, keep the patient in bed six weeks after the abscess is closed. In the latter cases keep on the long splint during the whole period.

"II. *Operations on parts where the skin is unbroken.*

"These cases come next in the order of simplicity of treatment, the essential object being, as in abscesses, to prevent the introduction of septic organisms during the operation; although the divided tissues are necessarily more or less exposed to the influence of the antiseptic in the spray and the sponges, etc.

"Prepare the skin, the hands of the operator, and the instruments, as

above, conduct the operation as usual, but keep the spray at work until the dressing has been applied, of course using the guard if the spray be suspended.

" When an instrument has been laid aside during the performance of an operation, it is an essential point, very apt to be overlooked, that before being reintroduced into the wound it should be again thoroughly cleansed with the carbolic solution.

" After securing the vessels, adjust a drainage tube, and stitch up the wound with carbolised silk . . . then dip a piece of protective, large enough just to cover the incision, into the solution, and lay it over the wound ; over this apply a piece of gauze wetted with the solution and the usual well overlapping dry gauze dressing. Change the dressing next day, and then afterwards dress more or less frequently, according to the amount of the discharge.

" In amputations apply a gauze dressing large enough to wrap round the limb, and to turn up over the face of the stump, like the wrapping at the end of a parcel.

" In primary amputations, and in amputations through limbs above the seat of putrid discharge, cover the contused or putrid parts with a towel wrung out of one to twenty carbolic solution, so that the sound parts may not become contaminated during the operation.

"III. *Accidental Wounds, including Compound Fractures and Dislocations, which do not require amputation.*

" Here opportunity having been afforded for the entrance of septic material before the case is seen by the surgeon, whether in the infliction of the injury or subsequently, the antiseptic must be introduced into all the recesses of the wound, in order to counteract the mischief so introduced. For this purpose a strong antiseptic solution must be used, but while it must be introduced among the blood-clots in the recesses of the wound, it is very undesirable that it should pass unnecessarily into the cellular tissue. In ordinary circumstances the one to twenty carbolic solution is employed, but instead of forcing it into the wound generally by means of a syringe, it is better to apply it to the various irregularities of the injured part by a flexible catheter adapted to the syringe with caoutchouc tubing. . . . . . .

" These operations are conducted under the spray after cleansing the skin with the one to twenty solution. If a fragment or an end of a bone is projecting, it is well washed with the same solution and returned, in some cases after sawing off its extremity ; but reduction is never effected until the depths of the wound have been injected, loose fragments and foreign bodies being of course extracted.

" It is difficult to assign the precise limit of time when antiseptic treatment must be regarded as hopeless in such injuries. Success has sometimes been obtained as late as thirty-six hours after the accident.

" The introduction of stitches should always be avoided in this class of injuries, and in some cases a drainage-tube should be inserted ; and if the wound is very small it should be enlarged to prevent tension from accumulating serum. The dressing is then applied as in the last class of cases ; the folded gauze being made to envelop the limb for a considerable extent above and below the injured part, in accordance with the large amount of bloody and serous discharge to be anticipated. A gauze padding for the splints in the vicinity of the injury is also often valuable as an additional precaution.

" The dressing should always be changed on the following day ; but afterwards, if all proceeds satisfactorily, the intervals between the dressings are increased as the discharge diminishes. It must, however, be borne in mind,

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that from the very nature of these cases—as some organisms in the recesses of the wound may occasionally elude the action of the antiseptic—success cannot be reckoned on with the same certainty as in the two former classes.

"IV. *Operations through parts affected with putrid sinuses.*

"These cases present the greatest degree of complexity in the antiseptic treatment. It is hardly to be expected that the putrefaction which exists in the recesses of the sinuses can be completely eradicated; but in a certain proportion of cases this is effected by the practice adopted in such circumstances, of injecting the tracks of the sinuses with the solution of chloride of zinc at the conclusion of the operation.* The chloride is at the same time applied to the cut surfaces, and by this means the patient is saved a great deal of pain and danger, as above alluded to—even should putrefaction ultimately show itself.

"The usual external antiseptic dressing is employed in the hope of an aseptic result, while it also protects the atmosphere of a hospital ward from foul emanations in case of putrefaction occurring.

"It is hardly necessary to say that the spray is not required in operations on this class of cases; it is, however, employed in the changing of the dressings so long as an aseptic result is hoped for."

* Recently, in some cases, the whole of the granulations are removed from the sinuses by means of sharp metal spoons. The sinuses are then washed out thoroughly with chloride of zinc, and the operation otherwise conducted as before described.

INJURIES & DISEASES OF SPECIAL TISSUES.

DISEASES OF BONES AND JOINTS.

LECTURE XXXI.

Diseases of Bone : their Nature and Modifications—The Anatomical Structure of Bone viewed in relation to its Pathology—Acute Ostitis and Periostitis—Local and Constitutional Symptoms and Complications.

In bone, as in all other tissues, diseased action is modified by texture.

The short and flat bones of the body—excepting those of the cranium—are composed chiefly of cancellated texture, enclosed in a thin fibrous shell. They therefore, as well as the articular extremities of long bones—on account of their loose structure—undergo morbid changes, somewhat analogous to those of the soft tissues.

The cranial bones have a very dense table internally, a tolerably dense one externally, and an intermediate medullary and vascular structure, the diploë. These therefore closely resemble the long bones as regards their anatomical structure and pathological changes.

The shaft of a long bone is composed of a very hard fibrous structure externally, which encloses a tubular cavity termed the medullary canal. On the exterior of such a bone we observe a number of small grooves or lines. If we look with a low magnifying power at a section of it, these broken lines are seen to be the oblique openings through which vessels pass from the periosteal surface into the dense texture of the bone. This dense texture of the shaft is very complex. In it are seen the Haversian canals conveying blood-vessels; and also canaliculi which serve to convey the blood-plasma to the lacunæ. This structure is evidently intended for the nutrition of the dense portion of the bone, and the cell-textures there have the power of attracting and assimilating that part of the blood required for their nutrition. In the ossified texture this could not be effected without the agency of such canals, and the canaliculi are for the purpose of allowing the blood-plasma to reach the corpuscular portion of the bone. The medullary canal in the recent state is full of a sort of cancellated texture, with large vessels ramifying through it. This is the medullary Haversian structure; it contains arteries and large veins and the medulla or marrow; this is continuous above and below, with the finer cancellated texture at the upper and lower extremities of the bone. The vascular supply of this central part of the bone is different from that of the hard portion,

which latter is supplied by vessels from the periosteum which pass into the Haversian canals. The Haversian structure of the medullary canal is supplied by certain large nutrient arteries, as they are termed, which pass through special foramina in the bone directly into the medullary cavity. These nutrient arteries ramify in the medullary Haversian structure, and anastomose with the vessels supplying the dense part of the bone.

The epiphyses of the bones are developed separately from the shaft, and are supplied by numerous vessels passing directly into them. Thus the shaft of the bone has two great sources of supply—one from the periosteum, the vessels of which ramify in the dense external structure, the other from the interior by the nutritious artery passing directly through the bone, and breaking up into branches in the interior of the medullary canal. The Haversian canals, though they are intended and serve to convey blood-vessels into the dense texture of the bone, have other uses. Each canal is lined with a thin delicate membrane, containing in it germinal cells. This, as pointed out by Goodsir, is in reality the formative portion of the bone. Its cells attract materials from the blood, and assimilate them for nutrition.

The periosteum invests the whole shaft of the bone as a distinct limiting vascular membrane, and allows the blood-vessels to pass through it. At one time it was disputed whether the periosteum was a simple fibrous investing or a formative membrane. It is now known, from the researches of Ollier of Lyons, that it is a complex structure, consisting of the proper fibrous membrane, and a lining nucleated or germinal membrane continuous with that of the Haversian canals. This internal membrane assists in the formation of new bone, but the fibrous periosteum has no power of so doing. The direct experiments on living animals, which used to be considered conclusive as to the formative power of the periosteum, were complicated with so many sources of fallacy, inseparable from the operative procedure, as really to prove little more than the undisputed practical conclusion that, if we destroy the periosteum, we give rise to a want of nutrition and loss of reproductive power just in proportion to the destruction of the periosteum and vessels passing from it into the bone. Some of these sources of fallacy I may briefly mention, having tested them whilst planning a series of experiments which I contemplated, but abandoned as not likely to be satisfactory—1*st.* On the limbs of dead animals I found it impossible, even with the most careful manipulation, to separate the periosteum from the bone to any extent, without at the same time drawing out in connection with it the vessels and membranes from the Haversian canals, and hence, apart from what Ollier has since pointed out, I saw that there would always be some germinal structure from the lining of the Haversian canals removed along with the periosteum, and in the living animal this would serve to furnish new bone. 2*d.* When the periosteum was separated, and an inch or two of bone resected and removed, leaving the periosteum; besides the source of nutrition above mentioned, the sheath of periosteum left, acted as a mechanical means of keeping up the continuity between the ends of the divided bone, and prevented other structures intervening. Whilst

when the periosteum was removed along with the bone, the divided ends were left loose and without any bond of continuity, and the muscles and other tissues around bulged into the intervening space in such a manner as would prevent all chance of union. So that there was nothing wonderful in the fact that in the latter case the bone should not unite. It was quite impossible it could do so. In some of Mr. Syme's experiments portions of tinfoil were placed between the periosteum and the bone, and it was found that new bone was thrown out between the tinfoil and the periosteum, but I know of no experiment showing it to be formed on the exterior of the fibrous periosteum. I believe, therefore, that the internal lamina of the periosteum, together with the continuous lining membrane of the Haversian canals, are the only formative textures engaged in the nutrition and reproduction of bone.

In the shorter bones, and in the cancellated texture of the epiphyses of long bones, the osseous structure is looser, yields more readily, and so allows changes to take place with less destruction than in the denser texture of the shaft. In the shaft of a long bone the veins are not large in proportion to the arteries, the returning circulation being principally carried on by large veins which pass out from the neighbourhood of the epiphyses.

Keeping these structural peculiarities in view, let us now proceed to consider the diseased conditions affecting bone. Like every other texture it is subject to inflammatory action; and you will easily understand, from what has been said, that the symptoms will be very intense, and the effects destructive. In inflammation of the soft parts the pain and risk are always less in proportion as the vessels can relieve themselves easily by effusion or exudation into the loose tissue of the part. The denser the texture, therefore, the greater are the destructive effects, and the more severe are the general and local symptoms. Whilst the soft tissues open out and allow a more healthy action to take place, dense textures, such as tendons and fasciæ, slough. They possess less vitality, and a comparatively small amount of exudation poured out into their structure produces destructive effects, and intense pain from the greater pressure on the nerves. When bone is inflamed all these conditions are at the maximum.

Inflammation of bone may be either *acute* or *chronic.* The former runs its course very rapidly, and from its usually destructive termination is sometimes spoken of as acute *necrosis,* or acute death of the bone. An attempt has been made to distinguish between inflammation of the periosteum and of the bone proper, but in truth we cannot have the one without the other, owing to the close vital connection between them.

The causes of inflammation of bone must be taken into account. These are either predisposing or exciting. The former are of two kinds principally—the strumous and the rheumatic diatheses—and superadded to these, accidental or adventitious predisposing causes, such as a syphilitic taint, or the long-continued use of mercury, or working among mercurials. The latter or exciting causes are exposure to cold or damp, or direct injury of the bone, leading to inflammation.

The most ordinary exciting causes of idiopathic inflammation of bone and periosteum are exposure to cold and damp in persons of strumous or rheumatic diathesis. The acute form occurs more frequently in the strumous than in the rheumatic, and generally in the young.

The symptoms of a typical case of acute ostitis are the following. The patient first feels pain in the bone of a very intense somewhat rheumatic character. This gradually increases. He becomes feverish, and has a slight rigor. The skin becomes hot, the pulse quick, and the intensity of the pain prevents the patient from getting any sleep at night. There may be no swelling of the limb noticeable, unless the bone be very superficial, nor is there much redness of the skin. The pain is felt along the course of the bone, and the disease, in this stage, is sometimes mistaken for neuralgia, and treated accordingly. The local symptoms and the symptomatic fever increase; the pulse becomes very quick, hard, and wiry; the tongue foul and furred. The pain is exacerbated whenever the patient takes any warm food. Redness and swelling now make their appearance over the bone, and the limb soon assumes the characters of erysipelas. The case may now be mistaken for one of acute phlegmonous erysipelas, and leeches are perhaps applied with some temporary benefit, or punctures or incisions are made with still greater benefit, or opiates may be given, and the patient obtains some rest. But the relief is only temporary; the pain returns; the fever alters in character; indeed, there is a great tendency for it to assume an irritative type from the first. The pulse becomes rapid and irritable; the tongue red and glazed at the edges, with a dry centre; and there is delirium at night. The secretions are arrested. The irritative fever sometimes succeeds on the symptomatic within forty-eight hours.

These conditions used to be attributed to the erysipelas having led to disease of the bone, but they are really due to acute periostitis and ostitis, the surface being affected secondarily from the inflamed bone. In such cases the periosteum is found very much thickened, and instead of presenting the usual thin appearance, it has become fleshy and highly vascular; and where it has given way, the bone is exposed—bare, white, dense, and smooth—with hardly any change in its structure; the diseased action having been too rapid to allow the dense portion to open out (plate xi. fig. 1). In the chronic form of inflammation time is generally afforded for the dense texture to open out, and for the vascular canals to dilate in proportion to the distension of the vessels, but in acute ostitis the action is too rapid for this; the exudation poured out blocks up the Haversian structure, and canaliculi, circulation and nutrition are arrested, and complete death of the part ensues. The denser structure of the bone does not allow of the vessels relieving themselves as in softer tissues, and the texture dies from the pressure of the exudation. The secondary effects, the redness and tense swelling, and acute œdema, arise from the vessels of the periosteum and of the soft parts becoming implicated. The inflammation then assumes the erysipelatous character. When the inflamed bone is deeply seated, like the femur, there is not generally at first much, if any, tension of the limb, and the cause of this should be understood. Between

Plate XI

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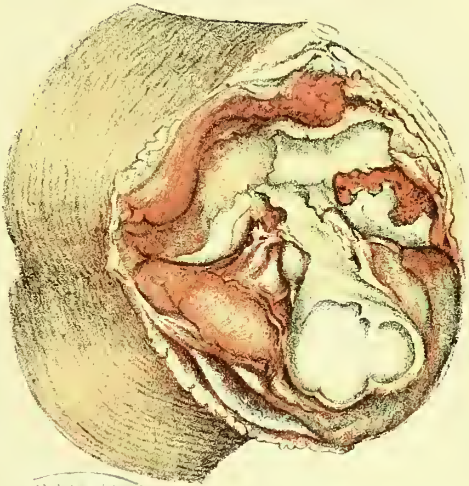


Fig. 4.

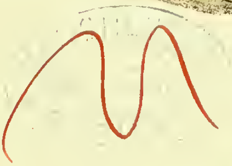


Fig. 3.

Fig. 2

Waterston & Son Edin. Lith.

the deeply-seated bone and the skin are very dense resisting textures. First, the effusion takes place into the loose tissue between the femur and the quadriceps extensor femoris, and is so limited. Next, the strong fascial textures resist the exudation from the vessels, which gradually relieve themselves into the loose cellular tissue between the skin and fascia, and then acute œdema supervenes long before there is any marked tension. In some cases, if the diseased action be not so severe, and if the patient be tolerably healthy—of the rheumatic rather than the strumous diathesis—the rapid death of the part may not take place, but the exudation will be poured out into the soft parts, and between the bone and the periosteum, where it can be more easily effused. This will give rise to alteration on the surface of the bone, and when the excited action has been subdued its effects are seen in a deposition of new bone on the surface, as in the specimens before you.

Where the diseased action goes on more slowly, the morbid changes also take place in a modified form. The inflammation affects different parts of the bone, which becomes irregularly shaped from the deposition of new osseous matter here and there. It may even be deposited in the interior, so that the bone becomes solid (figs. 19 and 20).

In very acute cases, the death of the bone may take place through nearly its whole extent, but this is very rare, and strictly speaking never occurs, for there are always certain portions separated along with the periosteum, leaving nuclei for the formation of new bone (plate xii. fig. 2).

Such are the symptoms of acute periostitis and ostitis. We should bear in mind that, in scrofulous patients especially, the fever which supervenes upon the symptomatic is almost constantly of the irritative type, and frequently complicated with diseases of other organs, especially of the kidneys and pericardium.

LECTURE XXXII.

Chronic Periostitis and Ostitis—Symptoms, Progress, and Pathology—Natural and morbid terminations, as Resolution, Suppuration, and Necrosis—Treatment of Acute and Chronic Periostitis and Ostitis—Of Necrosis and Suppuration of Bone.

THE symptoms of Chronic periostitis and ostitis are much the same as those of the acute form of inflammation of bone. They are slower in progress, and are otherwise slightly modified by the diseased action being less violent. There is generally a good deal of dull aching pain in the part, along with a feeling of tension. This pain is always deep-seated and more localised than in acute ostitis. Every now and then there is an exacerbation of the disease. All the symptoms become more intense at these times, and then the pain, tension, and other symptoms, are very similar to those of the acute form. The febrile symptoms are not so intense in chronic periostitis, for though sometimes there is a good deal of symptomatic or irritative fever, there is almost never the great constitutional disturbance which attends the acute inflammation of bone. There are two circumstances which mark the peculiarity of the inflammation of the osseous texture both in the acute and chronic forms—namely, the exacerbation of the pain which comes on whenever the patient gets warm in bed, and a similar result after he takes food. This symptom is the result of the excited circulation, and consequent distension of the blood-vessels in the unyielding texture of the bone. Both acute and chronic ostitis frequently terminate in necrosis. In the chronic form there is more time for the dense osseous texture to open out and allow the congested vessels to relieve themselves, and the diseased condition is thus so far modified.


Fig. 19.

In a bone affected with chronic inflammation, the Haversian canals are much larger and more opened out than normally; the dense texture of the bone is also lighter than usual (fig. 19). It becomes granular and spongy, and approaches in character the cancellated texture, though afterwards it becomes consolidated, when the diseased action goes on longer. There is often also a nodulated condition of the bone from the deposition of new osseous matter on the surface. The enlarged Haversian canals can then admit vessels of a very considerable size, which

Fig. 19. Porous enlargement of the tibia; the result of chronic ostitis.

are able to relieve themselves of their serous or plastic contents, and the symptoms of the disease are therefore rendered less intense; but in this, as in all other forms of chronic inflammation, the exudation tends to produce organic changes. A larger amount of nutrition goes on than natural; and at last the exudation becomes consolidated till the canal of the bone may be entirely closed, and in some cases become positively solid (fig. 20). The bone is thus enormously thickened and irregular; but when the diseased action ceases, gradual absorption takes place, and the bone tends to regain its normal form. Nodes, or masses of new bone, often form in the ostitis of syphilitic patients; they are also met with occasionally in those of a rheumatic diathesis.

Fig. 20.

In all cases of disease of bone, and of the periosteum perhaps more than the bone itself, there is a tendency for other fibrous textures to become affected secondarily. Of these the fibrous pericardium is that most generally attacked, especially in the acute form of periostitis in patients of a rheumatic diathesis; and we should carefully watch for this dangerous complication.

The terminations of inflammation of bone are various. The most favourable is resolution, in which the inflammation subsides, and the bone resumes gradually its normal character and type. In some cases there remains the deposition of new matter, forming irregularities or nodes on the bone.

Another termination of the disease is SUPPURATION. This occurs in two forms—1st. Sub-periosteal. An abscess may form between the bone and the periosteum. This result generally occurs after chronic periostitis in patients of an unhealthy constitution. There is slight redness, swelling, pain, and a feeling of fluctuation after a time, though it is only imperfect. It occurs principally towards the centre; there is some elasticity also towards the sides and base. The swelling may be pretty large, and yet contain very little purulent matter. On opening such an abscess we find a small quantity of greyish unhealthy-looking pus; part of it is a sort of gelatinous mass, and the rest looks like unhealthy serum. When we examine the fluid part we find pus-cells in it, but they are small and very imperfect, and there is a quantity of molecular debris mixed up with it. After opening the collection we find that the wound does not heal well, and it is this form of abscess which experience warns us against opening. As a result of acute periostitis we also often find pus forming in the soft parts around the bone, in consequence of the irritation produced by the inflammation; but in these cases the pus is generally healthy, and requires speedy evacuation. This is quite different from true periosteal abscess, which is a collection of ill-matured purulent fluid and a plastic exudation between the periosteum and the surface of the bone.

2d. An abscess may form in the interior of the bone itself. In the substance of the cancellated texture and condyloid portions of bones

Fig. 20. Consolidation resulting from inflammation.

in the neighbourhood of joints, abscesses often form with a distinct pyogenic membrane, the cavity of the bone being hollowed out, so that when the bone is cut into there is a gush of matter from the osseous texture. In bones like the os calcis they may also form and discharge themselves by destroying the thin shell of the bone, the cancellated texture allowing suppuration to take place much more readily than the denser texture would. Hence, in the articular ends of bone suppuration is much more likely to take place than in the denser osseous structure, where the same amount of irritation would probably lead to necrosis. In bones of a denser character, as in the lower jaw, abscesses sometimes form, and the bone is often very much thickened. In such cases we find that matter has formed at one point within the dental canal of the bone—which is partly composed of cancellated texture—and that its pressure has bulged the bone outwards. Sometimes there is thinning of the bone, as in the cystic tumour, or spina ventosa; but the true abscess of bone is generally attended with great thickening, not thinning of the walls.

It generally occurs in the cancellated texture, though it sometimes forms in the shaft of the bone. In the latter it never produces a very large abscess, because the whole bone becomes inflamed, thickened, and condensed. The patient feels the pain excessively severe and persistent, but localised to one point. There are rigors and other symptoms of suppuration, preceded by severe symptomatic fever, and intensified when the suppuration occurs. The symptoms are intensified here by the increased pressure produced by the pus developed in the dense unyielding tissue. When such an abscess forms, the medullary canal of the bone is not pervious throughout. There is a little bulging in front corresponding to what seems to be a node. The bone is much condensed in circumference, and the medullary canal is closed up by the exudation becoming ossified. There is thus a circumscribed abscess shut in on every side by unyielding texture. The pain and other symptoms are therefore very severe, and the diagnosis is very difficult, for it is almost impossible to say whether matter has formed. The localised pain, the rigors, and slight bulging give us some indications of an abscess having formed; but the absolute diagnosis by the feeling of fluctuation is out of the question, for it could not be felt through the dense structure of bone. Even in the lower jaw there is great difficulty in the diagnosis, and sometimes the jaw has been removed, under the belief that the swelling was due to a tumour, and not to an abscess. We should take the precaution of passing a trocar or a perforator through the alveolar process to see if there be any pus.

Fig. 21.

We shall now proceed to consider the treatment of acute and chronic periostitis and ostitis, and suppuration of bone.

Fig. 21. Large abscess of tibia. Bone much thickened and expanded round the cavity containing the purulent matter. Preparation in Royal College of Surgeons' Museum, Edinburgh.

In acute periostitis and ostitis a good deal depends on the conditions accompanying the inflammation—the state of the patient, and whether he be of a rheumatic or strumous diathesis. This form of the affection may supervene after debilitating disease, such as fever; exposure to cold. In such cases the patient is much weakened before the diseased action comes on, and this will modify the symptoms. In a typical case, when the acute inflammation has come on suddenly, with rigors and violent symptomatic fever, without much apparent swelling or discolouration, the first thing to do is to enjoin absolute rest of the limb, which should be perhaps somewhat elevated, the muscles being relaxed as much as possible. If the bone be deeply covered, leeches followed by warm fomentations may be applied to the part, so as to relieve congestion and relax tension by depleting the superficial vessels. The bowels should be freely opened, and opiates given to procure rest at night, combined with some medicine, such as ipecacuan or guaiac, to determine towards the skin and restore its secretion. Gentle diuretics may also be given to act on the kidney.

In most cases, however, these means are insufficient for relieving the symptoms. If the bone lie near the surface, like the tibia, and this is the bone most generally affected with acute periostitis, our measures must be more active. When redness and tension come on, as they very soon do, then free incisions should be made down to the periosteum. Sometimes even cutting through the periosteum will afford great relief, by allowing exudation to escape, and thereby preventing pressure. A mere linear incision will not necessarily lead to necrosis; it will in many cases prevent that result. After making the incisions, warm or anodyne fomentations should be applied; they will afford great relief to the patient. The symptomatic fever will thus be relieved, and the irritative fever prevented, or at least modified in character. The incisions always bleed smartly at the time; but we need not be afraid of dangerous hæmorrhage taking place—the loss of a little blood in fact does good. In cases, however, of acute periostitis after fever, we might hesitate to make incisions or punctures, or even to apply leeches, for fear of the bad effects of depletion on the patient when in an exhausted state. By delay in making the incisions, however, we keep up the debilitating cause and the irritation, and loss of sleep will do much more harm than the mere loss of blood. A boy of twelve had an attack of scarlet fever, and this was followed by typhoid fever. While recovering from the latter he was seized with sudden pain in the leg. Opiates were given to procure rest; but the boy could take no food, and, when wine or other stimulants were given, the pain was increased. The case was supposed to be one of erythema; but on examining the patient I saw it was a case of acute inflammation of bone—the boy being of a strumous diathesis. Notwithstanding his debilitated state, I made free incisions through the periosteum of the tibia, and thus relieved the symptoms greatly. After this the patient began to take proper nourishment, and got rest at night. He was not allowed to lose much blood, and recovered rapidly, without any exfoliation of bone or other bad symptom. This patient was very debilitated when the incisions were made, but had this not been done, he would

have suffered much more, and would probably have died from the febrile excitement attending the disease. This is an example of the proper treatment, and is an encouragement to proceed to active measures even under what seems to be most unfavourable circumstances, for by so doing we are much more likely to prevent necrosis, and we certainly relieve the patient's sufferings.

We do not require to adopt this treatment in all cases. When the tension is not so great, or when the bone is deeply seated, like the femur, it is not necessary at once to cut through all the muscular substance of the limb, for that would cause great risk of itself. In such cases warm fomentations may be applied, and depletion by leeches or cupping will be of service. When the patient is of the rheumatic diathesis, certain remedies are found to be very beneficial, such as ipecacuan with opium, or extract of colchicum, with a slight purgative, if necessary, especially in the chronic or sub-acute form of inflammation. In some cases the tincture of aconite, in small doses, will afford relief, but I have not the same faith in it as in colchicum. In chronic arthritic cases especially, the use of the bromide of potassium, in doses of 10 to 30 grains, or even more, will greatly allay the irritability of the constitution. The iodide of potassium is a remedy to which we trust much in the more chronic forms of inflammation, especially when we suspect any syphilitic taint—also in scrofulous cases; but it is of no use in the acute stage. When we want to get rid of some of the organic changes which have taken place—deposits between the bone and the periosteum—or, when the pain is probably caused by the exudation thrown out still remaining, the iodide of potassium, in 5-grain doses, twice or thrice a-day, will be found a very valuable remedy. In other cases belladonna may be applied on the surface, to relax the parts and relieve the pain; but this is merely a local anodyne application. As regards depletion in chronic periostitis, cupping or incisions are the best methods of effecting it; a soft poultice should then be applied to the part. Great care should be taken not to expose the patient to cold while cupping or leeching, as that will certainly do harm, and only a moderate quantity of blood should be abstracted.

In cases of abscess in the cancellated texture of a bone, when it does not communicate with a joint, if there be much tension, an incision should be made into it and a poultice applied to favour the escape of matter. Abscesses external to the bone must of course be opened at once, and the ordinary treatment of acute abscess adopted. In abscess in the cavity of a long bone (fig. 22), where there is a great difficulty in the diagnosis, Sir Benjamin Brodie proposed trepanning, which is the proper treatment when we are certain of the disease, as it will at once get rid of the excessively painful symptoms, and prevent further mischief, and even though no matter has formed the patient experiences great relief from the operation. In one case in which I was consulted I found that after an attack of sub-acute periostitis there was enormous thickening of the limb, the pain was intense and localised, there were repeated rigors, and the patient's health was failing. Trepanning was performed under the belief that an abscess had formed in the bone,

but no pus was found. A good deal of bleeding took place, but from the time the operation was performed the man began to recover, and was soon perfectly well. Thus in some cases, when the symptoms are

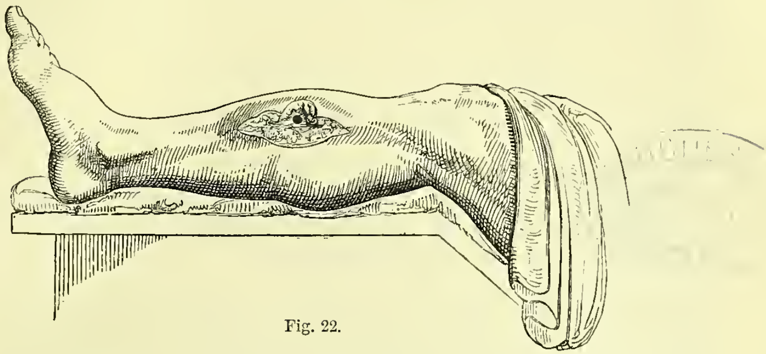


Fig. 22.

very severe, we may trepan, though the diagnosis be doubtful, for even if there be no matter little harm is done, and much good may result from the relief of tension.

In the true chronic periosteal abscess we should not open the abscess unless the case has advanced very far before we see it. Whilst there is still a good deal of thickness covering the parts, and when there is merely a pinkish blush on the surface, a blister should be applied over the abscess, and afterwards the part dressed with warm water lint. Under this treatment the swelling gradually becomes less and the matter is absorbed. I do not believe in any great absorption of purulent matter, but certainly in this form of abscess it does occur, for I have seen many cases of periosteal abscess disappear under the action of a blister, and the use of iodide of potassium. In these cases there is an alteration in the constitution of the secretions, such as the urine, showing that some organic matters are being eliminated. Such an abscess should certainly never be opened until we cannot possibly help it. If the abscess bursts, the opening should be enlarged to allow the free escape of the matter. If we do open the abscess, we find that the edges of the wound become everted, the gelatinous mass which forms the principal part of the collection becomes sloughy, the surface of the bone becomes exposed and is rough, brown, and granular, not unlike what it is in caries or ulceration of bone. If the abscess opens itself, or if it has been opened, the opening should be enlarged, so that the bone may be seen. A piece of lint covered with the powdered red oxide of mercury should then be applied on its surface. This acts as a stimulant without being a caustic, it destroys the vitality of the weak surface of the bone, which is thrown off as a granular discharge, and leaves a healthy surface below.

Fig. 22. Internal abscess affecting the tibia, near its centre. Cured by the traphine. Patient a policeman. æt. 22. Case narrated in Liston's *Elements*, p. 117.

LECTURE XXXIII.

Ulceration of Bone—Caries, definitions; pathological appearances; prognosis; treatment—Acute Curvature of the Spine, a result of deeply-seated Caries—Early manifestations and later symptoms of the disease—Treatment by constitutional measures; by mechanical appliances.

ULCERATION of bone may take place as a result of inflammation, as in the softer tissues, but it is attended with peculiarities arising from the structure of bone, and from certain constitutional conditions under which it is most liable to occur.

The exudation thrown out in the dense texture of inflamed bone interferes with nutritive action, and hence, when ulceration of bone has taken place, even in its simplest form, the healing process is slower than in the softer tissues. In cases, however, where there is no constitutional predisposing cause, simple ulcer of bone heals favourably. For example, when, from some local injury, abrasion of the periosteum has occurred, followed by inflammation and superficial ulceration of the bone, or when chronic ulcer of the soft parts over a superficial bone, as the tibia, has led to ulceration—under proper treatment, as by simple water-dressing or some slightly stimulating lotion, in such cases the surface granulates, a fibrous texture covers it in, and the soft parts close over it by secondary union. Again, in cases where pressure from a tumour or aneurism has led to ulcerative absorption of neighbouring bone, the diseased action is arrested so soon as the pressure is removed; there being no special cause in the bone itself preventing the healing process. These may be taken as examples of simple ulceration of bone, and they should be carefully distinguished from the form of ulceration termed caries.

Unfortunately, the term CARIES has been indiscriminately applied to all ulceration of bone, without much regard to the pathological conditions; and some of the definitions of the term would mislead us as to practice. Thus, Professor Syme says, "When the ulcer of the bone resists all means of cure, it constitutes what is called 'caries.' The distinguishing character of 'caries' is the same as that of cancerous ulcers —obstinacy of the disease." Now this is a very unfortunate definition, for the main character of cancer is wanting to complete the analogy. The great distinctive feature of cancer is not mere passive obstinacy of cure, but the aggressive destructive characteristic of malignancy—the tendency to involve all the neighbouring parts in the same diseased action. Mr. Liston used to define "caries" as a low form of ulceration in bone; the part possessing an amount of vitality sufficient to prevent

the affected surface being thrown off, but not having sufficient vitality to promote healthy action. This definition is nearer the truth, and is absolutely true at certain stages of the disease; but I believe that the peculiar obstinacy of a truly carious surface arises from the fact that a large part of it is really dead, and consequently requires to be removed by artificial or natural processes ere a cure can be effected. The older surgeons used to speak of moist and dry caries; the latter term denoting the more evident death of bone in sequestra or exfoliations—necrosis. For my own part I would have little hesitation in defining the actually carious surface as molecular necrosis. You may remember that, when explaining the process of ulceration in the soft tissues, I stated that it was a form of chronic mortification of part of the affected tissue; that owing to the quantity, and also in many cases the quality, of the exudation thrown out, it interfered with nutrition, and prevented or delayed reparative action. Now, in a texture like bone, you will readily understand death of portions of the dense texture is still more likely to occur; and in the looser cancellated bones, the dead portions are generally granular instead of separating readily in masses; in fact, that the form of death is determined or modified by the character of the texture in which this diseased action is situated, and hence the condition termed caries is almost confined to the short or flat bones, or to the articular extremities of the long bones—in a word, to the cancellated texture.

In Caries the portion affected presents to the naked eye a granular or reticular appearance, of a brown colour; it is greater in superficial extent than depth, and the surface is softer than natural—rotten as it were—so that a probe passes into its substance without any pressure being used (plate xii. fig. 4). The surrounding soft parts are swollen and irritable, with sinuses leading to the diseased bone, or thickened, with everted edges and pulpy projecting flabby granulations. I have said the surface is of a brown colour, and granular in appearance; but if we carefully macerate a portion of bone so affected, and examine it with a low magnifying power, we see that the granular appearance is due to minute white short hair-like spiculæ projecting from or lying on the surface.

A deeper section will show further changes in the bone beyond, which explain the low form of action and difficulties of repair characterising caries. The alterations of texture beyond the carious surface to which I allude exist in two different forms.

First, as we often see in the bones of the tarsus, the texture is opened out, and the enlarged cancelli are filled with altered medulla, or rather a lardaceous substance, varying in colour from a pale yellow to a dark reddish-brown or purple; and not unfrequently in certain bones, as the head of the tibia and the bones forming the elbow-joint, the cancellated structure is loaded with tubercular looking matter. The *second* condition is one more apt to be overlooked, but one which, if possible, shows greater alteration of natural structure. It is a condition the very opposite of the former, and consists in a peculiar condensation of the bone beyond the carious surface. It was first described in relation to dental caries by Mr. Nasmyth of this city; and the late Professor Goodsir has very well

described it in the caries of ordinary bone. "In true caries," says he, "for a certain depth below the surface of the affected part, the corpuscles and canaliculi have more or less completely disappeared, so that the subjacent unaltered osseous structure is covered in by a layer of apparently solid bone, resembling marble, and analogous too in some respects to the enamel of the teeth, amongst others in being incapable of absorption, and hence requiring either to exfoliate or to be removed artificially" (plate xii. fig. 3).

Now the first of these conditions shows a peculiar deposit infiltrating the cancellated texture, lowering its vitality, and predisposing it to an unhealthy form of ulceration. The second—the peculiar condensation of the bone underlying the carious surface—forms a barrier to the vascular supply necessary to support due vitality, and prevents absorption of disintegrated texture. Beyond the condensed structure, however, healthy action goes on, as is evidenced by the active deposition of new bone in the vicinity of the carious surface. To understand the true pathology of caries, however, we must look beyond the local changes to the constitutional conditions which induce and modify them. The carious ulceration is the result of a low type of inflammation of bone which is met with in two constitutional conditions—the strumous and syphilitic. Now, in both scrofula and syphilis, we find a tendency to deposits of vitiated albumen taking place in certain tissues, and bone is frequently so affected. In fact the exudation thrown out by inflammation in scrofulous and syphilitic patients is aplastic, and not fitted for repair, having little or no tendency to be converted into permanent tissue, and so, besides its bulk and pressure, interfering with vascularisation of the part; even when in small amount it remains inert, difficult of absorption, unfit for repair, and chiefly got rid of by disintegration and discharge. It is this condition, depending on the constitution, that leads to the local changes, and which renders the diseases of bone in such patients so difficult of treatment. Indeed, the surrounding soft tissues in caries show the same tendency even after the diseased bone has been removed; and it is all-important that we keep this in mind in reference to prognosis and treatment in cases of caries.

The progress of the local and constitutional symptoms in a case of caries may be briefly described. At first there is slight pain and indolent swelling in the neighbourhood of the diseased bone; gradually the deep-seated pain becomes more severe, the swelling becomes discoloured—of dark lake-colour, tense and shining, or else boggy; at last pus forms, and is discharged either artificially or by ulceration. The pain is now somewhat relieved, but the swelling remains indolent. In some cases the openings which have discharged the pus close, except small pouting orifices, which continue to discharge their gleety and often very offensive matter. When a probe is introduced into one of these openings it comes in contact with the carious bone. In other cases the openings of discharge extend by ulceration; the edges become infiltrated and everted; fungoid masses of unhealthy granulations occupy and project from the centre of the ulcer, and on destroying these the carious bone can be seen, presenting the softened rotten surface of the dark-brown

or purplish hue already mentioned. The severity of the pain and character of the inflammation which precede the suppuration and exposure of the caries are very variable. In some cases, as in articular caries, the pain is excessive, especially at night; and even in cases of caries of the tarsus or carpus, the pain and swelling are acute, but more usually the symptoms are such as I have described. The general health is often affected to a much greater degree than the local disease or amount of discharge from the surface or sinuses would account for; but then we must recollect that the disease is one of the manifestations of scrofula, and hence the hectic fever, constitutional irritation, and debility, which might, at first sight, seem to be out of proportion to the local cause. At the same time the caries is the exciting cause; and if the diseased portion of bone be removed, it is remarkable how rapidly the general and local conditions improve.

Keeping these things in mind, it is evident that our prognosis in caries must be favourable in proportion as the carious surface is limited and can be reached, so as to enable us to remove it before the constitution is exhausted by long-continued irritation. Hence, in cases admitting of operative measures for removing the diseased parts by excision or amputation, our prognosis is favourable as to the result, unless other organs be affected, which unfortunately is sometimes the case. In cases where the diseased bone or bones are so situated that we cannot interfere to remove the carious surface—as, for example, in caries of the bodies of the vertebræ—it must be evident that the result is more doubtful; and when repeated formations of abscess and long-continued purulent discharge have exhausted the patient, the prognosis is very unfavourable. Even such cases, however, are not hopeless, nor do I consider that caries is incurable except by operation, as some surgeons state. No doubt, when we can reach and remove the disease early by operation—as I have already said, that gives a great advantage; but we must not conclude, on the other hand, that cases such as caries of the spine are hopeless. They are often brought to a successful issue by proper treatment hopefully persisted in. The idea of their incurability is often the cause of their not being cured, by leading to trifling and intermittent instead of energetic and persistent treatment.

The *Treatment* of caries in cases which admit of operation might be briefly summed up as consisting in the early removal by excision, gouging-out, or amputation of the affected part. In cases where that is impracticable, absolute rest to the affected part, the use of the actual cautery as a counter-irritant before suppuration has set in, and the exhibition of chalybeate tonics, cod-liver oil, and nourishing diet—careful attention being given to the state of the different secretions and excretions.

It will be better, however, to take special cases of caries as illustrative of the treatment. Take, for example, a case of caries of the head and tuberosities of the humerus, where suppuration has taken place, and in which, through the opening of the abscess, we feel the bone bare. In such a case, so soon as the irritative fever had abated, I would proceed to excise the diseased bone at the shoulder-joint, so as at once to remove the disease, and to obtain a more useful movable limb,

than if the operation were delayed, and at the same time to relieve the constitution from the exciting cause of the exhausting discharge and hectic. The same rule applies with still greater force to the elbow and wrist joints. In the case of the knee-joint, the extent of disease and other conditions must make us weigh the comparative advantages of excision and amputation. Where one or more of the bones of the tarsus are affected by caries, the treatment will depend on circumstances. Thus, if the disease be confined, say, to one of the cuneiform bones on its upper surface, I would enlarge the opening leading to it, remove the exposed carious surface with the gouge, and when the oozing of blood had ceased, apply dilute nitric acid or finely levigated red oxide of mercury to the surface to cause exfoliation or destruction of any doubtful structure which might be left. In many cases this suffices; the soft parts heal, and the cure is effected. In some cases I have excised one or more of the cuneiform bones, and also the cuboid bone entire, with success; but these are always tedious, difficult, and uncertain operations, and in some cases diseased action is set up in the foot, leading to disastrous results. If the tarsus were pretty generally affected, I would amputate at the ankle-joint rather than leave the os calcis or astragalus, or any portion of them, as in such cases the risk of these bones assuming the diseased action is very great.

The foregoing are examples of cases in which the caries is so situated, that the surgeon can reach and deal directly with the diseased bone—cases, therefore, in which the treatment by operation or local applications constitutes the most evident indication, although constitutional measures are also important. As an example of the treatment of caries when so situated as to be out of reach of direct local interference, and as showing the curability of the disease even under such circumstances, let us take a case of caries of the bodies of the vertebræ.

This diseased condition, which in its advanced stages gives rise to acute projection of the spinous processes of the vertebræ affected, or ACUTE CURVATURE of the SPINE, has, from its true nature having been very accurately described by Pott, received the name of POTT'S CURVATURE. Essentially it consists in carious or ulcerative absorption of the cancellated structure of the bodies of the vertebræ, with alteration and destruction of the intervertebral substance, or elastic fibro-cartilage, causing the bodies of the adjoining vertebræ to approach each other, and so gradually to project the spinous processes until the projection becomes acute. Whilst this destructive process is going on in the bodies or anterior segment of the spine we generally find that a formative process is going on in the posterior segment, by means of which new bone is thrown out and the laminæ, perhaps even the spinous processes, are welded together by osseous union. This is a reparative tendency and counter-balances to a small extent the absorption of the vertebral bodies. Long ere any projection is noticeable, the real disease is in action, and as it is in this early stage we have most hopes of doing good, I will briefly point out to you the progress of such a case.

Caries of the bodies of the vertebræ, like most manifestations of scrofula, is a disease of early life, usually beginning in childhood; and for a time the disease may, indeed generally does, advance without

much pain or other marked symptom. The gait of the little patient, when walking, may attract attention. The head is carried erect and a little back, and the shoulders also seem carried well back, and as the child moves very circumspectly, it is sometimes noticed as having a "fine carriage." By-and-by the child is observed to be very cautious in going down a stair, or any declivity, and to complain of pain in doing

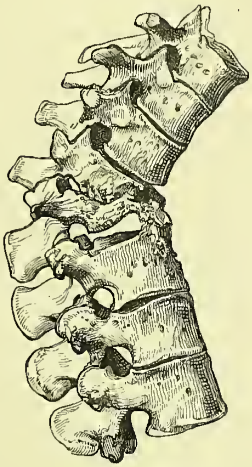


Fig. 23.

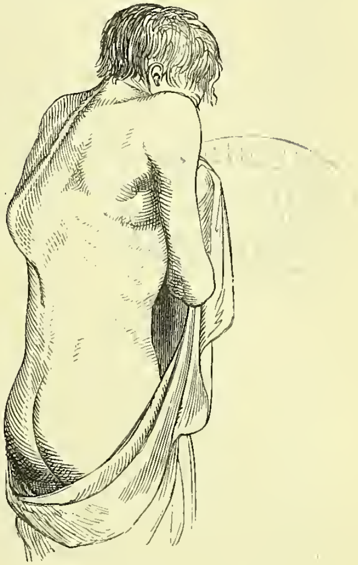


Fig. 24.

so, or after making any exertion. The general health now begins to suffer; there is heat of skin, restlessness and starting in sleep, and want of appetite. The patient cannot sit or stand long in the erect posture, and complains of pain at some part of the back. On examination there is a slight fulness observed at some point in the spinal region, and on pressure there the patient winces or screams. In most cases the abdomen is tumid, and the lower limbs wasted, and twitchings of the muscles of the limbs are noticed. If the spinal swelling be only slightly marked, and the pain not very severe on pressure on the spine, a very good method of diagnosis is to throw down some toy on the ground and bid the child pick it up. When the diseased condition is present, the child, instead of stooping in a natural manner, gets down on its knees to pick up the object. The movement of stooping in this instance elicits the symptom of pain, and the child has learned instinctively to avoid that movement.

In some cases, in very young children, twitchings and loss of power in the lower limbs first attract attention—these symptoms in many cases depending not on any direct pressure on the spinal cord, but on indirect irritation from the contiguous disease. As the disease advances,

Fig. 23. Caries of the vertebræ; macerated; the bodies extensively destroyed; marked incurvation forwards.

Fig. 24. The same during life

the symptoms become unmistakable, the spinous processes gradually become more and more prominent. These changes are attended by deep-seated pain and muscular twitching, and followed by gradual loss of regulating motor power. At length the curvature becomes very acute, and the stature of the patient is obviously diminished. After a time abscess forms, and the pus usually points outwards either in the lumbar or inguinal regions, constituting what is termed lumbar or psoas abscess. At this stage irritative or hectic symptoms supervene, and the patient may die from exhaustion, or the irritation caused by the carious bone may lead to inflammation and softening of the spinal marrow, or the cord may suffer from pressure caused by the absorption of the diseased bodies of the vertebræ, and the falling in and approximation of those above and below the disease. Then we have paralysis of the organs below the site of the affection, retention of urine with chronic cystitis, and loss of power in the sphincter ani. In such cases the irritation, after a time, is generally propagated upwards, and leads to a fatal issue.

The disease I have just described, arising from caries in the vicinity of an important vital organ, and so situated that the surgeon cannot reach it to remove the carious portion of bone by any operative procedure, is indeed an exceedingly dangerous disease, and would be utterly hopeless were the opinion correct that caries is only curable by excision of the diseased bone. In the latter or advanced stages the disease is very hopeless; but if properly and energetically treated at the earlier stages, we can do much to alleviate and often to cure the disease;—first, by allaying the deep-seated subacute inflammation of the bone, and so arresting the ulcerative process before much structure is implicated; next, by maintaining the parts as far as possible at perfect rest, and preventing the superincumbent weight of the head and trunk above the disease acting on the carious part of the vertebræ; and, at the same time, favouring the process of osseous or fibrous anchylosis.

To fulfil these indications, we at first direct that the child should be placed on a couch arranged on an inclined plane, and kept as much as possible in the prone position, so as to avoid all pressure on the spinous processes, and to take off the super-incumbent weight from the diseased part of the spine. The prone couch, as it is called, is usually fitted with a little table or slab of wood projecting in front, on which the child's toys are placed, so as to induce it to remain in the prone posture. Of course the child, when at all free from pain, will not remain in one position, it will occasionally turn on its side; but the form of the couch prevents it resting on the back, which we principally wish to avoid. During this stage, great attention is requisite to regulate the bowels and to nourish the child by diet, cod-liver oil, and chalybeate tonics, and to afford it as far as possible the benefit of fresh air and passive exercise. With a view to the last-mentioned objects, the prone couch may be fitted with wheels, so that the patient can be moved about the room, or out into the open air when the weather permits.

If there be much or persistent tenderness on pressure over the

spine at the affected part, with, perhaps, slight puffy swelling, the actual cautery should at once be applied at a little distance from the diseased point, so as to create counter-irritation and establish an issue. The effect of the cautery is often marvellous in arresting the deep-seated pain and allaying the diseased action. And when the eschar separates, the surface is slow of healing, and so the discharge is kept up for some time, and thus diminishes the deep-seated action. There is no other form of counter-irritation or issue equal to it, in cases of diseased bone; and as we can put the child under chloroform, the pain of the application is not felt. After the cautery has been applied, lint soaked in cold water, or a little weak aqua ammoniæ is used to allay the pain; then poultices are applied until the slough separates; subsequently, some slightly stimulating dressing—such as resinous ointment—is used to keep the sore open for some time.

As I have already intimated, great care must be paid to the constitutional treatment, by attention to the state of the digestive organs, and by tonic and nutrient regimen and diet to invigorate the general health.

After some time, varying from two to three months, if the pain and uneasiness have disappeared, we permit the patient to move about cautiously; but before doing so, a light spinal support, very carefully fitted, should be used, so as to prevent the weight of the part of the body above the disease pressing injuriously on the affected vertebræ. I am very averse to so-called "supports" in weak limbs or lateral curvatures as a general rule, but in this disease a well-made light support, resting on the pelvis, and supporting the body by rests under the armpits, is essential to the treatment, and admits of the patient using the lower limbs without risk.

In cases where suppuration has occurred before we see the patient, the cautery can hardly do much good. The abscess should be opened by the exhausting syringe, or with the trocar and canula, with the tube under water, as described in the Lecture on Suppuration (page 27). If the suppuration diminishes, then the cautery may be of use; but, as I have already said, the chances of successful treatment at this stage are very small. All we can do is to maintain rest in the prone position, and try to keep up the patient's strength, in hopes of arresting the diseased action. I have taken this dangerous form of deep-seated caries as an example of the method or principles of treatment to be pursued in all cases in which the carious bone is beyond the reach of direct surgical interference.

LECTURE XXXIV.

Necrosis, Idiopathic and Traumatic; Acute and Chronic; Superficial and Internal; Partial and Complete—Outline of the changes and appearances observed at the different stages of the diseased action—Local and Constitutional conditions which tend to modify that action—the Necrosis of scrofulous patients and its relation to Caries.

Necrosis, or death of bone, corresponds to mortification of the soft parts. It may result from external violence either destroying directly the life of the bone, as in some cases of fracture, especially gunshot fractures, or so injuring the surrounding textures that the vitality of the bone is affected secondarily, and so impaired that portions of it die and exfoliate; as we frequently see happen in severe injuries of the scalp, or in cases where the bone is extensively denuded of periosteum.

Necrosis, however, very frequently arises idiopathically, as a result of inflammation of bone, and generally in patients of the strumous diathesis, more especially when there is also a rheumatic complication.

Necrosis, as a result of inflammation of bone or periosteum, is seen in its most marked form when the dense texture of the shaft of a long bone is affected; and the progress of the diseased action can perhaps be most readily studied in the acute form in which it occurs in young persons. The symptoms and mode of invasion of that form I have already spoken of in my Lecture on Acute Ostitis and Periostitis. In these cases there is diffuse and violent action, not allowing time for the dense texture of the affected bone to open out, so as to accommodate the size of the Haversian canals to the distended blood-vessels, or permit of the latter readily relieving themselves by effusion. The plastic exudation which occurs fills up the Haversian canals, presses upon and interrupts the capillary circulation, and further extends to and blocks up the canaliculi and corpuscular portions of the bone. Thus vascular supply is diminished, and nutrition interrupted, in a dense unyielding texture, the vitality of which, owing to its peculiar nutritive apparatus, speedily yields to acute action, and acute or rapid necrosis is the result. A large portion of the surface of the affected bone is felt or seen to be bare, and generally of a white appearance, as in a cleanly-macerated bone, but occasionally of a brown colour, if there has been much disorganisation and decomposition of surrounding textures. In all cases of necrosis the pus, or discharges, have a peculiar fœtid odour.

In acute necrosis the actual extent of death of bone is less than it appears to be. Very often a mere thin layer dies and separates, and

Plate XII

Fig. 1

Fig. 3

Fig. 2

Fig. 4

that not from all the exposed surface. The surrounding soft parts are thickened and vascular; and more especially we notice changes in the periosteum, which has separated from the affected surface. It has a thick, fleshy, and extremely vascular appearance, and in its substance there are felt small nodules of osseous matter (plate xi. fig. 1). At one time these were considered as being formed in the periosteum; but if we carefully examine a recent preparation of a bone so affected, we find that, corresponding to each of these osseous masses in the periosteum, there is a depression in the dead surface of the bone from loss of substance. In fact, these osseous points are portions of living bone which have separated with the periosteum; a layer of granulations having separated them from the dead texture, gives them the appearance of being imbedded in the periosteum. In some cases, where the diseased action has affected the medullary Haversian structure, a portion of the shaft may die throughout nearly its whole thickness, but rarely, or rather I would say never (plate xii. fig. 2); for even in very extreme specimens a longitudinal line of irregular rough surface marks where a portion of living bone has separated from some part of the circumference.

In the more chronic forms of necrosis, or, to speak more properly, where necrosis results from a more chronic form of inflammation, the symptoms, though often severe, are much less painful, and unattended with the peculiar irritative fever which accompanies the acute form. The pain is more of a rheumatic character; and it is only when some exacerbation leads to subacute inflammation and suppuration near the diseased bone that sympathetic febrile symptoms arise. In these chronic cases the slower action permits of gradual changes taking place. The Haversian openings and canals gradually enlarge from the pressure of the distended vessels, and the whole aspect of the shaft of the bone at the affected part is altered. New bone is deposited in irregular masses near the diseased part, owing to the excited action determining more blood to that part, and so increasing the nutrition of the bone around the dying portion. Wherever we find a completely smooth portion of dead bone, there the new or substitute bone is at first wanting; but the space may be gradually bridged over from the side of the neighbouring shell (plate xii. fig. 1). This deficiency of substitute bone seems to arise partly from the want of any nuclear portion of bone, and on account of the diseased action having destroyed the germinal lining structure of the periosteum at the parts corresponding to the completely smooth dead surface. At these open spaces the purulent matter formed around the dead or dying bone escapes; and as the substitute shell closes in around, the pus keeps some points open, and thus the cloacæ in the substitute bone are formed (fig. 27), and these again are continuous with the sinuses or cloacæ in the soft parts.

After a lapse of several weeks the dead portion becomes separated from the living bone, and is ready to be thrown off naturally or removed by the surgeon. The complete separation of the dead bone from the living is always a slow process, even in acute necrosis, seldom occurring until six or seven weeks from the commencement of the disease, often very much longer, and in some cases only gradually accom-

plished, one small portion separating after another. This is especially the case when the medullary Haversian structure is affected. The portion separated is termed either exfoliation or sequestrum, according to its form. Thus the superficial thin laminæ of dead bone separated

Fig. 25.

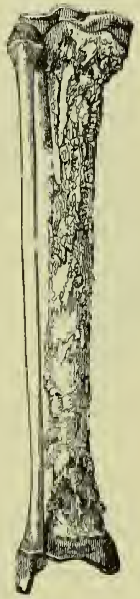


Fig. 26.

Fig. 27.

from the cranial bones, from the popliteal space of the femur, or from the surface of the tibia, in acute necrosis, are termed exfoliations; whilst the larger cylindrical portions, comprising a considerable thickness of the bone, or portions of dead Haversian structure from the medullary canal, are termed sequestra.

Necrosis may either be superficial or internal. In the latter case, or in cases where a considerable cylindrical portion of the shaft of a bone dies, as the process of separation is slow, new bone, as I have said, forms around or bridges over it, and so forms a barrier to its extrusion. Hence, in the two last-mentioned forms of necrosis, the substitute bone must be destroyed by the ulcerative process to make way for the exit of the sequestrum ere nature can extrude and so get rid of it; and I need hardly say that this is necessarily a very tedious process. The sketch I show you (plate xi. fig. 2) is from the case of a woman aged 30 years, in whom the disease began when she was about 13 years of age. I had seen her from time to time during fifteen years on account

Fig. 25. Acute necrosis of the tibia. The bone extensively perished at *a;* the cortical formation has begun to form. Fibula, as usual, unaffected.

Fig. 26. Necrosis of tibia; more advanced. Cortical formation investing the greater part of the old bone.

Fig. 27. Necrosis of tibia; in the chronic stage. Cortical, or substitute bone, complete, and consolidated. At several points cloacæ seen, leading down to the sequestra.

of exacerbations caused by the presence of the sequestrum, but she refused to submit to any operation. At last the sequestrum was extruded by the natural process, so that I merely required to draw it out with my fingers, but this only after great suffering and risk. The sequestrum was composed of about three-fourths of the thickness, and nearly the whole length, of the tibia of a girl of 13 years, and maintained its original shape, marking the period at which its death had occurred.

The presence of a sequestrum in the vicinity of the articular end of a bone is always attended with risk of exciting unhealthy inflammation in the cancellated texture of the epiphysis, and so involving the joint; and this complication forms an important element in our prognosis as to the probable termination of the case, or in regard to surgical interference.

Death of a long bone throughout the whole length and thickness of the shaft is occasionally spoken of by surgical authors, and formerly the long sequestra resulting from acute necrosis used to be appealed to as evidence of this—the rough irregular patches on their surface, or the deficiency in their circumference, being attributed to the action of the absorbents on the dead bone! (Plate xii. fig. 2.) No one now believes in this action of absorbents, and I have already explained that such deficiencies are due to the separation of portions of living bone during the progress of the disease. If death of the entire shaft did occur, we would expect to find the bone lying loose from the periosteum, unaltered in form, and presenting a uniform smooth surface like a macerated bone, and separated at either extremity from the epiphyses. But though my own museum presents a very large collection of specimens of necrosis and some very large sequestra, and though I have examined carefully many public collections at home and on the Continent, I have never yet met with such a specimen as death of the shaft of a long bone in its entirety. Even in the most rapid cases portions of living bone separate from the shaft along with the periosteum, or in connection with the epiphyses.

In some cases, after sequestra have been removed or thrown off by the efforts of nature, the discharge does not cease, but continues thin and gleety, and the constitution begins to suffer. In some cases the discharge is so copious as to be exhausting and demand very decided measures. In others, an unhealthy fungoid growth springs from the cavity, bleeding occasionally, and so exhausting the patient. This last condition occurred in the case of the woman already referred to, and was accompanied by all the symptoms of malignant action. She was yellow from anæmia caused by loss of blood, worn to a shadow, and there were enlarged glands in the groin. These symptoms supervened about eighteen months after the sequestrum had been extruded, and I amputated her thigh some three or four months later, and she made an excellent recovery. All the symptoms were due to exhaustion from pain and loss of blood, not to malignant action, and I have seen several cases of somewhat similar kind.

In some instances where necrosis occurs near or at the junction of the shaft with the epiphysis, deformity occurs in consequence of the

epiphysis getting loosened and altered in its relation to the shaft, as we often see in necrosis in the lower part of femur in children.

The appearances of a limb affected by necrosis will vary under different circumstances. In a thickly covered bone, such as the femur, the inflammatory swelling and pain which precede necrosis give rise at first to tension, acute œdema, and deep-seated suppuration; so that all the soft parts of the limb become altered, thickened by infiltration of plastic exudation and solid œdema, so as to become firm and unyielding, and present openings of sinuses leading, more or less directly, to the diseased bone. In necrosis of a superficial bone like the tibia, in acute cases, we have the swelling and erysipelatous redness of the skin, effusion of lymph into the subcutaneous areolar tissue, and when abscesses burst or are opened, and when incisions are made, we see the dead bone bare and white. In chronic necrosis of the tibia, the deposit of new substitute bone altering its form, and the thickening of the whole limb caused by solid œdema, give the leg an unshapely appearance; whilst the skin is usually congested and discoloured, and, as in all cases of necrosis, we have the cloacæ or sinuses leading to the sequestrum, or cavity where a sequestrum has been.

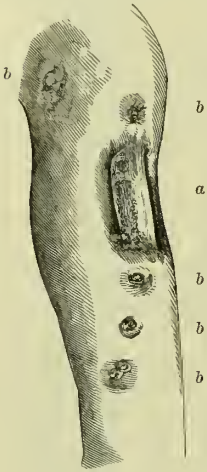


Fig. 28.

The constitutional symptons will vary as the necrosis is acute or chronic. In the former we have all the intense symptoms I described when speaking of acute ostitis and periostitis, the worst form of irritative fever and exhaustion. After this stage is passed, and when death of the bone has taken place and suppuration begun, the irritative fever is relieved; but hectic, more or less marked, sets in. In chronic cases there may be severe exacerbations depending on formation of abscesses, but the irritative fever is never so intense as in the acute form. When suppuration occurs and is kept up by the presence of the dead or dying bone, hectic symptoms occur as after the acute, being caused in both cases by the continued irritation and discharge.

There is a form of necrosis which is occasionally met with in extremely strumous patients, or in persons of strumous constitution, with a syphilitic taint, either hereditary or acquired. The symptoms are generally of a low type. There is but little preceding inflammation or swelling of the limb or bone. An abscess may form, enabling us, after opening it, to touch bare bone at some one point only; whilst, in fact, the whole, or a large part of the shaft, is affected by little patches of necrosis, the dense structure of the shaft is opened out and carious-looking, and there is little or rather no attempt at repair—no new bone thrown out around the dead portion. In this form the bone is very friable, and fracture is apt to occur. In the case of the lad from whom I obtained the specimen I show you, an abscess formed in the

Fig. 28. Necrosis of tibia. At *a* the dead bone exposed. At *b*, *b*, the sinuses represented, communicating through cloacæ with the sequestrum.

popliteal space, and the surface of the femur there was felt bare and rough. As it did not exfoliate, he got tired and left the hospital. I was sent for to him in a great hurry shortly afterwards, and found the femur broken a short distance below the lesser trochanter. I had him carried to hospital, and there amputated the thigh just below the trochanter. There had been no swelling, pain, or deformity, nor any symptom of disease, except at the popliteal region, and yet you see the state of the bone at the broken part, and for some extent upwards and downwards from that point. The lad made a good recovery from the amputation, but when about to leave the hospital general dropsy suddenly supervened, with albuminuria; this yielded readily to treatment, and after being in the country for some months he returned quite ruddy and feeling strong, but his urine was as albuminous as when he left. I saw him from time to time for seven years, always seemingly in good health, no œdema or other bad symptom, but the urine always so coagulable by heat as to be nearly solid. He was suddenly seized with lumbar pains; suppression of urine took place; and when I saw him, twenty-four hours after his seizure, he was comatose and moribund, and died two hours later. I mention this case and show you the specimen as typical of this form of patchy necrosis.

Before proceeding to speak of the treatment, I desire to draw your attention to the necrosis of scrofulous patients and its relations to caries.

Most of our surgical works would lead us, by their language, to suppose that in constitutional forms of necrosis if we once but remove the "sequestrum," all will go on satisfactorily. Such, however, is very far from being the case in many instances, and for this simple reason, that the originating or predisposing cause, the constitutional diathesis, still continues after the local irritation has been removed; and hence, in many cases after removing a "sequestrum," we find the exposed surface still continues to discharge, and fresh portions become necrosed—nay, in many cases the cavity left after removal of the necrosed portion continues to furnish discharge so persistently as to exhaust the general health, and necessitate amputation to save life. Again, we meet with various forms or modifications of the disease. In some the death of a portion of the affected bone is rapid and complete, and a comparatively healthy surface is left; or the reparative efforts of nature may have furnished a case of substitute bone ere the sequestrum is thrown off. In others the progress is slow, the affected bone retaining slight vitality, and not becoming completely separated for a lengthened period—the texture of the bone from which it separates is seen to be discoloured, friable, and of low vitality; and in other cases we find the shaft of a bone affected at different points, with independent patches of necrosis, without the slightest effort at repair.

We have already examined the condition termed caries. Let us now compare it with necrosis, and ascertain in how far these conditions differ from or resemble each other in their essential nature, whether they be absolutely different diseases, or merely the same diseased action, differing in degree, or modified by the texture of the bone in which it occurs.

When we view two specimens, such as caries of the articular surface of the tibia and necrosis of the shaft of a long bone, there seems at first sight but little in common; but it is not by extreme forms that we must judge of the essential character of disease, but by tracing it through intermediate links, and having done this, we will often find, even in the extremes, more points of resemblance than at first appeared. Thus, if we take a specimen of incipient necrosis of the popliteal surface of the femur, we find the affected part of a brownish colour, of more granular appearance, and more friable than natural, but still possessing some vitality; and making allowance for the naturally denser texture, not much unlike the surface of bone exposed in articular caries. Again, in advanced stages of articular caries itself, we often find large exfoliations or sequestra of the cancellated structure separating, constituting necrosis. In certain bones, especially the lower jaw and tibia, we meet with what has long been termed molecular necrosis: that is, the dead surface gradually becoming disintegrated, and being thrown off in particles so minute as to be almost imperceptible, until the whole diseased portion is eliminated and a healthy surface left. In cario-necrosis, as it is termed, we have a combination of the two conditions in the different textures of the same bone, showing that it is the texture which modifies the diseased action. Thus, in the bones of the tarsus and carpus, the cancellated portion presents the appearance described as caries, whilst the denser fibrous lamella is completely dead and exfoliating. We meet with this condition also in some rare cases in the shaft of long bones where the bone has undergone chronic alteration of structure, and has become opened out in texture, so as somewhat to resemble cancellated bone, and presents an unhealthy friable appearance with small patches of exfoliation at different points, and scarcely any attempts at repair or deposition of new bone. I have a very perfect specimen of this rare form, which occurred in a lad whose case I have already adverted to. Another very rare specimen in my possession shows the effect of diseased action simultaneously affecting the whole extent of the femur, from the hip to the knee-joint, in a young girl; here the form of disease, as depending on structure, is beautifully seen, the dense shaft has been rapidly deprived of vitality, whilst the head and condyles are in a state of cario-necrosis. Lastly, let us return to the ordinary carious articular surface, and examine it more closely with a low magnifying power, and we will find that a large proportion of it is composed of fine white spiculæ, evidently deprived of vitality, and about to be separated from the living bone.

But it is said that the progress of the two diseases is different; that necrosis is amenable to treatment, whilst caries is incurable. Let us examine, for a moment, into this opinion, as to the peculiarly incurable nature of "caries" in comparison with necrosis.

I apprehend that all that is meant is just this, that the actually carious portion is incurable, and of this there can be little question; the part so diseased must either be thrown off by nature, or artificially removed; but wherein lies the difference between it and necrosis in this respect? The part actually necrosed is also incurable, and it, too, must either be thrown off or removed before a healing process begins;

at the very most, the difference is that the carious surface possesses some slight degree of vitality, which renders the process of exfoliation or disintegration by molecular necrosis slower, and is rather a modification of diseased action from the structure of the cancellated bone in which it occurs, than a different disease. But then it may be said that there is more meant by the incurability than this, for we see that "caries" in the articular extremities of bones leads to such exhausting disease as to destroy the patient, or necessitate amputation or resection, much more frequently than "necrosis." This is simply to say, that from the *relative* position of the diseased portion of bone, general disease of the articular structures is induced, and so the patient's life endangered and severe operations necessitated.

As regards the distinctive definitions, that caries implies an ulcerated surface of bone, possessing a low degree of vitality, sufficient to prevent its being thrown off, but insufficient for undergoing any healthy action, whilst necrosis indicates complete death of the affected portion,—these may be correct etymologically, as indicating different stages or degrees of diseased action, or rather the action and its result, and I have no objection to the terms, as used for that purpose; what I wish is, to ascertain whether the original essential nature of the disease, however modified, be the same in both cases. But even the slight vitality of the carious surface may be doubted; for when we look at the white, spicular, and altered structure, we see but little to indicate vitality; it is, in fact, molecular death; whilst here, as in ordinary necrosis, we have active reparative efforts at deposition of new bone. In fine, we see, in many cases of necrosis of the shafts of bones, carious-looking bone, beyond the exfoliation, and in many cases of "caries" distinct exfoliation going on.

What, then, is the essential nature of these conditions? I hold that they are both manifestations of scrofula, affecting the osseous texture, leading to altered and impaired nutrition, predisposing to and often exciting an unhealthy form of inflammation. In other words, the unhealthy and impoverished condition of the blood, characteristic of scrofula, furnishes an exudation of plasma less fitted for proper nutrition, under ordinary circumstances, or to resist disease when excited, and under certain conditions undergoes peculiar and abnormal transformation. Thus, as we see, the deposition of tubercle in some textures, or the gelatinous degeneration in synovial membranes, so in bone, the unhealthy blood-plasma exuded from the capillaries ramifying in the Haversian structure leads to the diseased states I have been considering. We observe this most evidently in the altered condition of the cancellated texture of bones in strumous patients, where the altered medulla or lardaceous deposit is so marked, that we frequently see, under some increased irritation, tubercular alteration and ulceration occur. Here it is easily recognised, because the looser texture and greater vascularity of the cancellated bone favour its occurring more readily and in a larger quantity, whilst the same conditions of the bone prevent the diseased action leading to rapid or complete death.

In the shaft of a long bone, or in the fibrous shell of the short and flat bones, a much less amount of such exudation, slightly if at all

capable of healthy transformation, blocking up the Haversian structure, speedily leads to complete death of a portion of such bone, when affected by any increased irritation from disease or injury. We see this well exemplified in the cases termed "cario-necrosis" of the tarsal bones, where, under excited action increasing the imperfect plastic exudation, the denser shell dies rapidly, and exfoliates, whilst the looser cancellated part loses its vitality more slowly, presenting at some points the molecular disintegration or ulceration, at others deposition of new material, leading to the condensation of the texture, as described by Professor Goodsir. In some cases we have this also exemplified in a general disease of the shaft and epiphyses simultaneously, in the specimen of the femur already alluded to.

As to practice, these views will modify our prognosis. Thus, whilst they show why the diseased condition is generally more persistent and intractable when it occurs in the cancellated texture, they also point out how, in some cases of caries, by a process of molecular death, the unhealthy surface of bone may occasionally be disintegrated, thrown off, and so a cure be obtained. They explain the reasons why the cure in strumous necrosis of the shaft is generally so tedious, and often imperfect, even after the removal of all sequestra, and also the tendency to affections of the articulations supervening both from direct extension of disease and from constitutional diathesis. Lastly, they show us the necessity for patience in the treatment after the removal of large sequestra, and for the careful and persistent use of constitutional remedies.

LECTURE XXXV.

Treatment of Necrosis, before, during, and after the separation of sequestra—Sub-periosteal operation in Acute Necrosis—Method of conducting other operations for removal of Necrosed Bone—After treatment—Question of amputation—Rachitis or Rickets—Mollities ossium.

WHILST lecturing on acute and chronic ostitis and periostitis, I described fully the remedial measures necessary to fulfil the indications of treatment of the conditions which terminate in death of the bone. When the more acute action has been subdued, and when the irritative fever which accompanies it has somewhat subsided, and hectic has supervened, the treatment is at first limited to securing absolute rest of the limb, by laying it on a wire splint suspended from a cradle, and to careful watching so as to notice and evacuate early any abscesses which may form. We apply charcoal paste or warm-water dressing sprinkled with carbolic acid solution or chlorinated soda lotion to the surface, to correct fœtor. The patient's strength should be supported by means of nutrient diet, and wine or other stimulants, according to circumstances, and the use of muriated tincture of iron in small doses. We must wait patiently until the sequestrum or exfoliation becomes loose and separated by nature, to effect which, as I have already said, several weeks at least are required. After the lapse of five to six weeks, we may examine with the probe, to ascertain if the dead portion be loose or loosening; but this should be done as seldom as possible, and no force used. It is sometimes difficult to be sure whether a sequestrum is still attached to the living bone—not fairly thrown off; or whether it is merely fixed by some process of substitute bone, or by irregularities of its deep surface caught by corresponding irregularities of the living bone. This difficulty in diagnosis is most likely to occur in internal necrosis, and if the sequestrum be flat. When there are two or more cloacæ leading to the sequestrum from different aspects of the limbs, we will often find that whilst the probe cannot move the sequestrum when introduced by one opening, if we introduce it by the opening on the opposite side of the limb we at once displace and move it readily. I have also found it useful to examine with a steel probe terminating in three short thick points, which catch the smooth surface of the sequestrum and move it if it be loose, instead of moving on its surface. In superficial necrosis, as that of the cranial bones or tibia, the exfoliation is frequently detached vitally, but remains attached by mechanical cohesion of the opposed surfaces and atmospheric pressure; and whenever we raise the

edge of the exfoliation and tilt it a little over, the whole comes away readily.

In deep-seated necrosis, where the sequestrum is imprisoned in the medullary cavity of the bone, or in a case of new substitute bone, and where we feel it loose, or where we know that due time has elapsed to insure its having separated vitally, we must have recourse to operative interference for its removal, so as to prevent it from exciting mischief in neighbouring joints or other parts.

There is one class of cases of necrosis in which subperiosteal surgery seems likely to achieve some brilliant successes: I mean cases of the acute form, in which inflammation of the dense shaft of a long bone has been so rapid, general, and violent, that nutritive changes seem arrested; and the bone separated, or nearly separated, from the investing periosteum, is exposed, with its surface bare, smooth, and white, as if dead. Although in such cases the constitutional disturbance, at first from irritative fever, and subsequently from hectic, always places the patient's life in great jeopardy, and though the tendency of the local action to spread to the epiphyses and involve neighbouring joints is very great, we have hitherto been content to wait patiently, often most anxiously, for nature to separate between the dead and living bone, before interfering. In cases where the state of the patient seemed to point to amputation as the only chance for life, the results have been so unsuccessful, that I think it scarcely warrantable. Now, however, by separating any remaining connection of the periosteum, and resecting and removing the diseased portion of the shaft, the long process of separation is avoided; the constitution is saved the tax on its powers from discharge, irritation, and hectic; the periosteum which is left furnishes new bone to take the place of that removed by the surgeon; and the limb gradually assumes its normal form and usefulness. Here, it would seem, we have clear advance in the treatment of disease; and I believe it is a real and great progress. Still we must look at it carefully from different points of view, so as to make sure of this, and avoid injury to the method from its being practised indiscriminately, or in improper cases, or during unfavourable conditions. We must remember that in what we call acute necrosis the loss of vitality seldom extends to the whole thickness of any great length of the bone; that, whilst the periosteal sources of nutrition may be largely or entirely cut off, the vascular supply and nutrition of the medullary canal and the ossific centres may not, and rarely are so to the same extent; and hence we can never be sure for some time how much of the affected bone may really perish, whether there may be a large portion to separate ultimately, or merely superficial exfoliations; or, as I have known, the whole surface of a long bone like the tibia may be exposed bare and white, and yet granulate and heal without a vestige of exfoliation occurring.

But, whilst I think it right that these things should be kept in mind, lest we interfere ultroneously and remove texture which natural processes would have saved, on the other hand, looking at the matter practically, when we see a patient suffering from hectic or occasional hæmorrhage from ulceration of vessels near a diseased bone, and

when we consider how long he must be exposed to such sources of debility before the dead bone separates, and the risk of the implication of neighbouring joints occurring and necessitating amputation, I am shut up to the conclusion that resection and removal of the affected bone must be often indicated; and that, if the cases for its performance be judiciously selected, and the operation be properly effected, this method will be found to be a most valuable addition to our resources.

The important question, no doubt, arises, How far can we trust to the reproduction of new or substitute bone from the periosteum, when the whole thickness and nearly the whole length of a long bone like the tibia has been removed by operation? And this question not unnaturally suggests itself, because we know from experience that under the expectant plan, when large and long sequestra were removed, the thickness of the shaft was never renewed to its full extent, although under that method we had both bone and periosteum to furnish new material. Here, for example, is a specimen, showing a large sequestrum removed when loosened by nature, and a cast of the leg showing the appearance of the limb after the cure was completed. During last winter, Dr. MacDougall of Galashiels, now of Carlisle, exhibited a child to the Medical Chirurgical Society of Edinburgh, in whom he had resected the tibia in a case of acute necrosis, and the thorough reproduction was well seen, and the use of the limb was perfect. I lately operated on a similar case, and resected the shaft of the tibia close to the epiphysis at each end, after separating the periosteum, with a successful result; so that I think we may trust to the periosteum for entire reproduction of the part removed.

To these and similar successful cases it may be objected that in cases of compound fractures, when the broken bone protruded, divested of periosteum, resection of the denuded bone was, and is frequently practised; but experience has shown in such cases that, when the portion of bone so removed is large, reunion is almost never perfect; the ends of bone are atrophied and joined together by a tough fibrous material; or, in the case where there are two bones, as in the leg and forearm, the ends of the resected bone approximate and unite with the other bone. A little consideration, however, will show that there is really no parity between such cases and resection for acute necrosis, because in the case of compound fracture the periosteum is not merely separated, but is generally so torn and bruised that its vitality is destroyed, or so impaired that its reproductive powers are rendered very imperfect; whereas in necrosis its vascularity is increased, the membrane thick and flesh-like, and it almost invariably carries with it small nuclear portions of bone tissue.

The operative procedure for resection of the necrosed shaft of a bone is very simple. Esmarch's apparatus is applied so as to prevent all loss of blood. The existing sinuses or undermined integuments are laid freely open along the line of the diseased bone, so as to expose it freely. Next, the surgeon, using a thin flat blunt elevator, such as that used in separating the periosteum from the hard palate in cases of staphyloraphé, gently separates any remaining attachments of the periosteum, and if any small laminæ of new bone have been thrown

out, he should be careful to separate them in connection with the periosteum. He then, by means of a probe or blunt pointed needle, passes a fine chain saw through beneath the upper end of the diseased shafts, and if the saw be kept tense and straight, a few strokes suffice to divide such a bone as the tibia. Raising the sawn end of the bone carefully, the chain saw is slipped down towards the lower end of the diseased shaft, and resection completed. The shaft being lifted out and removed, the cavity is syringed or washed out with a solution of chloride of zinc (one part to thirty) and firmly stuffed with slips of lint dipt in carbolised oil. Over this a piece of waxed paper is laid, and then a compress of dry lint, and the limb bandaged firmly from below upwards. The circular india-rubber compressor should not be removed until the patient is placed in bed, so that no loss of blood takes place, and if the cavity has been properly stuffed, none is likely to occur.

Some of these operations for necrosis are tedious and laborious, especially in chronic cases, where the substitute bone is thick and almost of the density of ivory. There is no possibility of laying down positive rules for such irregular operations; but there are certain points which should be specially attended to.

First, as regards hæmorrhage. Means must be taken to arrest bleeding during the operation, as the vascularity of the textures, and their almost cartilaginous thickness by preventing the retraction of divided vessels, cause the hæmorrhage to be always very smart and often profuse; and as such operations are frequently protracted, the loss of blood might be serious unless the precaution of using a tourniquet were adopted. The method of Esmarch, by using the india-rubber roller to expel the blood from the part of the limb to be operated on, and the strong india-rubber tubing to constrict the limb and act as compressor, effects the object in view perfectly, and hence enables us to see the parts on which we operate as in a dissection, and prevents all loss of blood during the operation. It is a most valuable assistance to us in such operations as those for necrosis and resections of bones and excisions of joints. In many cases of removal of large sequestra, or resections of the shaft of a bone especially, we can, by stuffing the wound with oiled lint, and applying a compress and bandaging the limb before removing the circular compressor, render the operation absolutely bloodless. Secondly, we must not only make our incisions in the soft parts free, but in order to reach the diseased bone, we must dissect them back on either side; as they are altered and thickened, and do not retract as they would in the natural state of parts, we can gain no room but by dissecting. This dissection, of course, is limited to laying bare the substitute bone to a sufficient extent to enable us to deal with it according to circumstances. Before proceeding to operate, we if possible ascertain the length and thickness of the sequestrum, its proportion to the cloaca or opening in the substitute bone, and the probable thickness of the substitute bone, and are so far prepared to act on some plan. It will often happen, however, that on laying bare the bone we find it necessary to alter our proposed plan, and hence our apparatus should in this operation be ample. The instruments usually

required in dealing with the bone are, the trepan, straight and curved bone-pliers, a fine narrow saw, gouges of different sizes, necrosis forceps straight and bent, probe, elevators and ordinary dressing or polypus forceps, for small sequestra or narrow openings. When the sequestrum

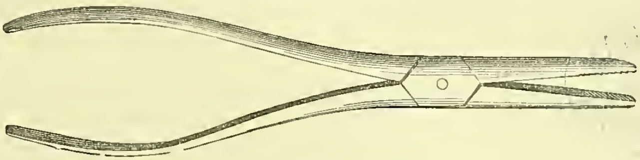


Fig. 29.

is large and long, and the substitute bone not very thick on one side, as little of the latter as possible should be removed. In such cases we try to catch and divide the long sequestrum across by means of bone-pliers, then push the fragments up or down, and extract first the one and then the other through the opening in the substitute bone (plate xii. figure 1). In other instances, where the case of new bone is very dense, we apply the trepan to make an opening in it, and enlarge that further with a fine saw or bone-pliers, till we can insert and use our extracting forceps. In such operations the trepan is always preferable to the trephine, as it renders the operation less fatiguing to the surgeon, and works more rapidly, and there is of course no risk in using it here. In some cases we split up a large sequestrum, both longitudinally and transversely, and extract it in small portions, so as to save the substitute bone. In dealing with superficial necrosis, or with sequestra, where little new bone has been thrown out, there is not much difficulty experienced in detaching and removing them.

After operating on cases of necrosis, the bleeding is to be arrested, large vessels must be tied; but as the profuse bleeding alluded to formerly, arises from the general vascular surface, as already stated, we usually command it by stuffing the cavity with lint. The density of the textures favours compression, so that bleeding is in general very easily arrested. After the operation is completed we place the limb in a splint and swing it, to insure rest and prevent fracture of the substitute bone at any weak point. The after-treatment is simply that of a granulating wound.

In cases in which sequestra have been removed, and where discharge continues, exhausting the patient, whilst no dead bone can be felt, we must lay open the cavity in which the sequestrum had been situated, and insert a slip of lint soaked in tincture of iodine or other stimulant, to excite healthy action and destroy the pyogenic membrane. Stimulating lotions should then be injected from time to time, until the soft parts contract and close in upon the cavity. In cases where large sequestra have been removed, or where the substitute bone is not much developed, or in which we require to remove a large portion of it to reach and remove a deep-seated sequestrum, it is advisable to place the limb on a wire or light wooden splint, and sling it, so as to give support to the remaining substitute bone, and prevent fracture, either from the patient turning in bed or from the action of the

Fig. 29. Necrosis Forceps.

muscles. And this is absolutely essential when there is only a single bone, as the femur or humerus.

The constitutional treatment in cases of necrosis must be carefully attended to. Nourishing diet, cod-liver oil, preparations of iron—especially the phosphates—and iodide of potassium, are indicated to support the patient's health, and act as alteratives on the strumous diathesis.

The question of amputation frequently arises in the treatment of necrosis under different circumstances. I would therefore now conclude this subject by directing your attention to the conditions under which this question may arise.

In cases of acute necrosis of great extent, when the patient is suffering from irritative fever, with symptoms almost of blood-poisoning, and when the intense suffering, gastric irritation, and debility, leave us little hope of his being able to pass through the long process required for throwing off the dying bone, amputation presents itself as a chance of relief, but I would strongly guard you against giving way to the temptation. These conditions which tempt you are no doubt most dangerous, and it is quite possible that your patient may sink under them; but they are conditions most unfavourable for amputation, and after much experience in the treatment of such cases, I tell you that the patient has a much better chance without the operation. When the irritative fever ceases, and hectic fever with profuse discharge takes its place, when the tongue cleans, and the perspirations are profuse, if your patient's health is sinking, or if neighbouring joints become affected, then amputate. But even in hectic cases, where there is no joint implicated, it is wonderful what a youthful patient will get through. Therefore exercise patience, and don't be too ready with the knife. Perhaps one of the most difficult lessons we have to learn by experience is when to watch disease and do nothing.

In cases either of acute or chronic necrosis, when neighbouring joints become diseased, and discharge and pain give rise to hectic wasting; or when, as often happens, the necrosis is attended with altered position of the epiphyses, rendering the limb irremediably deformed and useless, then amputation is evidently indicated as the best means of removing at once the cause of irritation which is exhausting the patient and a useless and deformed limb.

Another condition generally requiring amputation is fracture of necrosed bone, as in patchy necrosis, where there is little or no tendency to substitute bone being formed; or in cases where the substitute bone breaks after a sequestrum has been removed or thrown off. In the former of these cases, the peculiarly unhealthy state of the bone, and the absence of reparative action, leave little or no choice but to amputate. In the latter our decision will depend on circumstances. When such an accident occurs in the humerus or femur, where there is only a single bone, the chances of solid union are very small, especially if the patient be debilitated by previous suffering. In the femur, under these circumstances, besides the risk to life from increased irritation and discharge, the limb saved would be very useless, or perhaps worse than useless; and hence amputation would be the

proper practice. In the case of the humerus, however, the chances of repair are greater, the treatment is attended with less risk to the patient, and does not necessarily imply confinement to bed or in the house. The arm can be placed in appropriate splints and slung. And supposing—as may often happen,—thorough union of the humerus should not take place, the upper arm can be fixed by apparatus, and the use of the hand and forearm retained. Here, as in cases of injury, we should never resort to amputation whilst a chance remains; and, I may add, our efforts are usually successful. I have never amputated the arm, nor can I recollect ever having seen amputation performed, for such a cause.

Where there are two bones, as in the leg and forearm, amputation for fracture of substitute bone can rarely be requisite. In the forearm it would seem to me to be quite unwarrantable. Even in the leg, though the fibula is of itself a very slight support, yet it suffices to maintain the position of the limb at first, and the ends of the broken substitute bone of the tibia, if they do not unite with each other, become connected with and strengthen the fibula. Lastly, in cases where, long after sequestra have been removed, the cavity continues to discharge unhealthy pus, notwithstanding that it has been laid open and treated with iodine or other stimulant applications, or in cases where fungoid growths spring from such cavities, and are exhausting the patient by discharge and loss of blood, amputation becomes absolutely necessary to save life.

One of the many forms in which the scrofulous *diathesis* seems to manifest itself is the disorder which is known by the name of Rachitis or Rickets. This, together with the apparently allied diseases mollities ossium and fragilitas ossium, will form the conclusion of the present Lecture.

Rachitis and mollities ossium have one common feature, inasmuch as they are both diseases characterised by a preternatural softness of the osseous textures, due to a deficiency of their earthy constituents. In rickets this deficiency is due to non-development and mal-assimilation of the materials necessary to the formation of bone, while in mollities ossium it arises from absorption and degeneration of already existing bone. The one is therefore a disease of childhood, the other of advanced life.

Rickets occur in children either as a primary disease or as a consequence of the debility induced by infantile complaints, such as measles, scarlatina, hooping-cough, and the irregularities attendant on dentition. Most usually the subjects of it are originally of weak constitution, and, as I have already indicated, it has always been regarded as one of the many manifestations of scrofula. Still, we must bear in mind that although often very closely associated with scrofula, it does not seem to possess a well-established claim to the hereditary character of that disease. The children of very young parents are peculiarly liable to it, and that independently of any already existing disease.

Although softening of the bones, and the resulting deformities, are the most prominent effects of rickets, yet the disease presents many

other symptoms. The patients have a pale sallow complexion, and are dull-looking, fretful, and peevish. The body is generally attenuated, or if not, the flesh is soft and flabby, not firm and bright as in health. The chest is contracted and deformed, the belly prominent and tumid. The lower limbs, being unable to support the body, become bent and twisted under the conjoined forces of gravity and muscular contraction. Bending of the limbs, however, does not necessarily imply the presence of rickets, for the limbs of any child, however healthy, will become distorted if it be allowed to rest its weight upon them too early, and before the shafts of the bones have become sufficiently ossified to sustain it.

In rickets, not only is there a deficiency of earthy matter originally, but there would almost seem to be a want of power in the system to assimilate the earthy salts, for during the progress of the disease there is often a great elimination of phosphate of lime from the system, as shown by deposits in the urine. In rickets, however, the soft, cartilaginous, or opened-out structure of the bones is only temporary, it being, as I have said, a disease of childhood and youth. After a time earthy matter is deposited in the bone, which then becomes firm, but porous and generally light in texture, often much bulkier than natural. In the shafts of the long bones the curvatures which had taken place during the soft stage remain, and so the bone becomes permanently deformed, unless means are used to obviate this. Every museum possesses numerous illustrative specimens, and in examining these you will observe that there is always a large deposit of ossified matter in the concavity of the curve, similar to what occurs in badly-set fractures; thus the maximum of strength is obtained by the minimum of expenditure of material.

All the other bones may be similarly affected, but more especially those of the cranium, which become greatly enlarged, as they do in chronic hydrocephalus, and indeed these two diseases are not unfrequently associated with each other.

In females, it would seem as if rickets sometimes occurred at a later period of life in consequence of debility induced by leucorrhœa, menorrhagia, miscarriages, and floodings. When the bones of the female pelvis are so affected and distorted, and again become firm from earthy deposit, the deformity is rendered permanent, and constitutes an obstacle to delivery during subsequent labour.

The *Treatment* must be chiefly directed to the constitution. Fresh air is of the greatest consequence. Passive exercise should be recommended, but only of a very gentle kind, and not carried so far as to produce fatigue. Tepid water, and even sea-bathing, is very beneficial where judiciously conducted, and accompanied or followed by gentle and somewhat prolonged use of the flesh-brush.

The diet should be nutritious, and carefully regulated in accordance with the digestive powers of the patient, and wine or other stimuli may be given if necessary. Formerly preparations of lime were freely administered, but that practice arose from misapprehension regarding the nature of the disease, and was therefore useless, or worse. The diseased state consists, not in any deficiency of earthy matter, but in the want of power to assimilate it. For this reason the medical treatment

ought to be directed towards the restoration of that power, and for this purpose preparations of iron, cod-liver oil, and especially pepsine wine, seem to be the most suitable remedies, together with such gentle laxatives as may be required for the proper regulation of the bowels. The use of pepsine wine seems to be specially beneficial, as it improves the digestive powers and so assists nutrition.

In the local treatment of this disease mechanical appliances may be necessary. These are designed with a view to assist the lower extremities in sustaining the weight of the body, and prevent them from being injured by the superincumbent weight. They should not be had recourse to without great caution, and, if used, should be constructed with the greatest care and of very light materials; otherwise they will tend rather to aggravate than remedy deformity.

I have mentioned gentle exercise, but this must of course be regulated by the stage and extent of the disease. Thus, when the bones of the lower extremity are soft and pliable, walking or standing is obviously contraindicated; and frequently the patient requires to be kept in the recumbent position. In slighter cases care must be taken to prevent the patient from remaining long in one posture, either in standing or sitting, or whilst engaged in writing or drawing, as the position so assumed very frequently becomes permanent. Gymnastics, therefore, ought to be so regulated as to meet the morbid tendency.

MOLLITIES OSSIUM is the term which is generally applied to that condition in the adult or aged which resembles rachitis in the child. This resemblance, however, only holds good as regards the softening of the bone which is found to exist in connection with each, for pathologically there is no similarity whatever between the two diseases. The one is a suspension of the functions of assimilation in regard to the formation of bone, and is only of temporary duration. The other is an atrophy or degeneration of bone already existing, which is not temporary but progressive, and continues to extend from bone to bone, without any interruption or attempt at reparation, until at length the general health becomes involved, and the patient dies from exhaustion.

Various opinions are held as to the true nature of the changes which take place in the bones during the progress of this disorder, and indeed there is reason to believe that the changes are not the same in every case. Sometimes the earthy matter of the osseous texture seems to be absorbed, and its place filled by a brown lardaceous soft substance; whilst in other cases the change seems to partake more of the character of a simple softening. Mr. Paget seems to view the disease as a fatty degeneration of bone, similar to that which occurs in other textures late in life, and the correctness of this opinion receives strong confirmation from the results of the analysis of such bones, for they are found to contain free fat in very large proportions. Rokitansky, on the other hand, seems to hold that the changes consist in simple softening of the bone, from abstraction of its earthy matter, and persistence of its cartilaginous base, constituting rickets of the adult. This latter class of cases is that already alluded to as occurring in adult females, and is a distinct disease from true mollities, which is continuously progressive.

Mollities ossium is always attended with intense and incessant pain, which increases with the progress of the disease. The patients become enfeebled and emaciated, their appetite fails, they are sleepless, irritable, and subject to profuse perspirations. So that, in addition to the local discomfort, there are very marked evidences of a constitutional cachexia; in fact, the symptoms present all the characters of malignancy.

From what I have stated regarding the *progress* of the disease, you will no doubt gather that the *Treatment* can only be of a palliative kind. The indications are to regulate the digestive organs, preventing torpor of the bowels, and to exhibit anodynes from time to time, for the relief of pain.

Fragilitas Ossium denotes a condition of the osseous textures characterised by great brittleness. A certain degree of fragility occurs naturally in old age. This is due to the altered relative proportions of animal and earthy constituents of which bone is composed at that period of life. That condition is much aggravated by the co-existence of certain forms of disease—such as rheumatism. It may also occur purely as a consequence of disease, and that at any period of life. In these cases the bone assumes a friable condition, and may snap across from the slightest cause, even from the simple action of the muscles, constituting in that case what is sometimes termed spontaneous fracture. In cancerous affections this fragility is often present, consequent upon the deposit of cancerous matter in the structure of the bone.

When fracture does occur under these circumstances, union is always slow and imperfect, if indeed it take place at all.

The *Treatment* must be preventive and palliative, for we cannot avert or arrest the alterations in the osseous tissue. The diet must be nutritious, and the patient cautioned against making any exertion lest fracture should occur. The fractured parts must be kept at perfect rest.

LECTURE XXXVI.

Diseases of Joints: how modified, according to the structure affected; whether Osseous, Cartilaginous, Fibrous, or Synovial, etc.—Acute Idiopathic Inflammation of Joints: Causes; Symptoms; Pathology and Treatment.

Owing to the variety of textures which enter into, or are connected with, the structure of articulations, you will easily understand that their diseases are both numerous and complicated; and whether they be regarded as to their effects on the usefulness of the limb or the state of the general health, or both, they demand great attention from the surgeon, in reference to their diagnostic symptoms, pathology, and treatment.

In investigating the symptoms and pathology of diseases of joints, as bearing on diagnosis and treatment, we must carefully bear in mind the peculiarities of the anatomy, and the greater or less degree of vitality of the different structures entering into the formation of the joint. The anatomical peculiarities of the articular extremities of bones have been already noticed; but besides these peculiarities, as compared with those of the shafts of bones, we must here bear in mind their relation to the articular cartilage which encrusts them. This structure, finely organised, in one sense—for the purpose of protecting the osseous texture and admitting of free smooth motion—is of very low organisation as regards vitality. So far as the most careful modern investigations go, it presents neither vessels nor nerves in its intimate structure. Its nutrition seems to be entirely derived from the plasma attracted by its cells from the loops of capillaries which ramify on the surface of the articular ends of bones in connection with it. In such non-vascular structures the vitality is not only low, but also closely bound up with the condition of the neighbouring textures on which they depend for their supply. On the other hand, the protection which the cartilage of incrustation affords to the articular ends of bones during motion or contact, explains how certain symptoms arise, when, either by acute or chronic action, the cartilage has been removed, and this protection more or less lost.

In some articulations we meet with what are termed inter-articular fibro-cartilages. These, owing to their fibrous connections becoming relaxed or destroyed, may become sources of mechanical obstruction to movement, and lead to or keep up irritation in the joints. The true fibrous ligamentous texture of joints, whether in the form of capsular, flat, or cord-like ligaments, possesses the usual characters of fibrous tissue; a dense resisting strueture with a moderate vascular supply and innervation. This texture is capable of undergoing rapid alteration of struc-

ture from acute inflammation, or gradual change and thickening from chronic inflammation, also calcareous alteration, or ossification as it is sometimes termed.

The most peculiar anatomical structure in joints, perhaps, and that which is most frequently affected either primarily or secondarily, is the synovial membrane. This invests the articular ends of bones, the cartilage of incrustation and the internal surfaces of the fibrous structures of joints being reflected from off one surface to another. The synovial closely resembles the serous membranes in their anatomical arrangement and functions. Like them they are shut sacs, possessing a smooth serous-looking surface, and their function is to secrete a lubricating fluid, the synovia, which, though more viscid than serum, serves similar purposes. Although the membrane is apparently possessed of little vascularity in its ordinary state, yet under any irritation its vessels readily enlarge, the membrane becomes injected, and its secretion increased and altered. This vascularity spreads rapidly and diffusely over its free surface, inducing changes in action, and affecting indirectly other textures.

Besides the articular structures proper, there exists, near most articulations and around tendons, another apparatus very analogous in its structure and uses to the synovial,—I mean the bursal texture. Bursæ mucosæ, as they are named, are just sacs of synovial character, placed over joints or bones, or between tendons and the skin or muscles, to protect them from external pressure, and at the same time permit of easy motion. They are sometimes formed adventitiously when a part is exposed to continued abnormal pressure. Their anatomical character, the nature of their secretion and functions, differ little, if at all, from those of the synovial sac, and there is therefore considerable similarity in their pathology.

Requesting you to keep in mind these general views of their structure, I now proceed to speak of the diseases affecting joints.

Inflammation of a joint may arise idiopathically from some constitutional predisposition, such as the rheumatic, strumous, or syphilitic, excited perhaps by exposure to cold or damp, or without any very obvious exciting cause. Or it may arise from injuries, such as sprains, bruises, or penetrating wounds. The invasion and progressive symptoms of the inflammation will be modified by the circumstances giving rise to it, and our prognosis will be much influenced by the constitutional predisposition or diathesis of the patients in whom it occurs.

In cases where the inflammation arises from cold or damp, it generally partakes more or less of the rheumatic character, and the fibrous articular textures are first affected. There is not much swelling at first, but deep-seated pain in the part, aggravated by motion, especially by particular movements in different joints. The pain is most severe at night, and partakes of a peculiar tense aching character. Febrile symptoms supervene. The pulse rises, becomes hard and frequent. A hot dry skin occasionally alternates with profuse perspirations. The tongue is foul and loaded, and the urine scanty

and high coloured. Sometimes the fever is, from the first, of the irritative type.

When these symptoms have continued for a short time, swelling begins, at first slight and œdematous, in consequence of the vessels relieving themselves into the areolar texture external to the fibrous ligaments, and thus filling up the depressions, so that the natural form of the joint is somewhat lost or altered. Shortly, however, the synovial membrane becomes involved. The pain then becomes more diffuse, and of an acute character, and the joint becomes distended with increased and altered secretion, causing either a uniform swelling or bulging at those parts where there is least resistance. Thus, in the knee-joint, if the patient be recumbent, the swelling is at first greatest on either side of the ligamentum patellæ, and over the lower and fore part of the thigh. If the patient be erect, the bulging is over the upper part of the tibia. Laterally and posteriorly the strong fibrous structures resist the distension for a time, though by-and-by they gradually yield before the pressure of the fluid. In cases where the joint is superficial, as the knee, the skin becomes hot and often inflamed, and either tension or acute œdema may arise.

When the synovial membrane is primarily affected by inflammation, the pain is generally of an acute character, and is referred to one particular spot at first. The patient often says that he could cover it with the point of his finger, and this even when from the swelling it is evident that the action must be diffused. The same peculiarity as to the localisation of pain is often observed in cases of pleurisy, and occasionally in peritonitis at the commencement. In synovitis the progress of the swelling is more rapid than when the fibrous textures are originally affected; but in either case, when once the synovial membrane is involved, the after progress of the symptoms, whether local or constitutional, is the same.

As regards the physical signs. In cases of synovitis, in addition to the swelling, we have in the early stage, before effusion is extensive, a feeling of friction on moving the surfaces gently on each other. Or a friction-sound is heard if we apply the ear over the joint when slight passive movement is made, but we elicit it most readily by manipulation. When the effusion into the joint is considerable the friction is lost, but is felt again as the effusion becomes absorbed.

The pathological changes which arise from simple inflammation of joints are thickening and altered form, and after a time either softening or chronic consolidation and shortening of the fibrous ligamentous structures, and in some cases fibrous anchylosis and distortion. In synovitis we find at first effusion or exudation of lymph on the free synovial surface, giving it a granular appearance, and leading to the friction of the surfaces already mentioned. Next rapid effusion of thin, almost serous synovial secretion collects within the joint. In some cases plastic lymph is effused between the opposed surfaces of the synovial sac, forming adhesions. These are short and soft when recent, but when old they gradually elongate to admit of motion, and become thin and membranous, similar to what we see in old adhesions of serous membranes; this result, however, is comparatively rare in the synovial.

In some cases, where the joints have suffered from repeated attacks, we find some slight alteration in colour, opaque patches, or thickening, and nothing more. In others, and especially in rheumatic cases, a very peculiar fimbriated structure is found, and sometimes projections of a kind of fatty alteration in large masses.

Inflammation of a joint may also lead to suppuration. Then the tension increases, the fever becomes intense and of an irritative type, and finally hectic supervenes. When this happens, it is often followed by disorganisation of all the articular structures, but such a result seldom occurs in cases of rheumatic or simple synovitis. Generally it arises in connection with some strumous condition of the constitution, or takes place when the inflammation supervenes in consequence of penetrating wounds.

The *Treatment* of acute idiopathic inflammation of joints must be active at first, both in reference to constitutional and local measures, modified of course by considerations of constitutional tendencies and the state of the patient's health.

When acute articular inflammation arises in a robust healthy person, local depletion by cupping or leeches should at once be had recourse to. After blood has been removed in sufficient quantity to diminish the active congestion, the limb should be placed on a well-padded light wire or wooden splint, and slung so as to ensure absolute rest. Warm anodyne fomentations should then be applied constantly for some time, or if these be intermitted, the part should be covered with sheet wadding to protect it from cold. Some gentle alterative laxative should be given, and this should be assisted by an enema, so as to prevent the patient straining when the bowels act. When the bowels have been well opened we should give an opiate; either Dover's powder, or a dose of Battley's solution of opium with a few drops of ipecacuan wine, may be given to act both as an opiate and a diaphoretic. In some cases, when the pulse is very hard and quick, minute doses of tartar emetic with opium may be given, but in most cases I prefer the ipecacuanha. In cases where the rheumatic diathesis is very marked, colchicum wine or small doses of aconite are indicated as special remedies. Also the use of ærated potash-water with lemon-juice for a drink when the patient is thirsty and the urine scanty.

In the after stages of the disease, when acute action has somewhat diminished and the fever is passing off guaiacum, or the tincture of Actæa racemosa in from 16 to 20 or 30 minim doses, may often be given with advantage internally. The local application of blisters or other counter-irritants is of great use in helping to get rid of the chronic congestion and effusion. Some precautions are, however, required in applying blisters in joint-diseases, more particularly when the affected joint is superficial. In all such cases, before using counter-irritation, we should continue the fomentations or anodyne lotions until the temperature of the skin over the affected joint becomes the same as that of the general surface. If this precaution be not attended to, we are apt to re-excite action in the joint and do harm instead of good. In the after-treatment, when uneasiness and stiffness remain,

we should use anodyne liniments, either simple or combined with iodine, or paint the skin over the joint with iodine, and give support by bandaging, so as to maintain rest of the parts and promote absorption. At this stage the use of iodide of potassium internally is of great service in preventing those chronic changes of texture which are apt to arise from exuded lymph. After a time, passive motion at first, and then gradual active motion of the limb, should be encouraged, and the warm douche used to the joint and neighbouring parts, followed by friction with the hand.

In those cases of articular inflammation known as gonorrhœal rheumatism, active depletion is rarely indicated, but in other respects the general indications are similar to those already stated. If the patient has been using balsam of copaiba or cubebs in any form, these remedies must be abandoned and other means used to allay the urethral irritation. In such cases we generally try, by means of warm bathing and other measures, to restore the urethral discharge temporarily.

When acute or subacute inflammation attacks the joint of a strumous person, our prognosis, as I have already indicated, is less favourable, as chronic changes of a scrofulous character are apt to supervene on the irritation so excited. In such cases the use of depletion by cupping or leeching must be very cautiously employed, if employed at all, for we must keep in mind that there is in such constitutions little reparative power, and hence we should avoid the withdrawing of blood from the system. In some few cases, however, where the pain is intense and the inflammatory action violent, the local abstraction of a small quantity of blood may serve to check the disease at less expense of vital power than would be sustained if the symptoms were allowed to progress. As a general rule, however, we restrict our treatment to perfect rest, anodyne applications, and the constitutional remedies already indicated.

Chronic Synovitis may either result from the acute, or the action may arise in a sub-acute or slow form. In either case the symptoms are similar though less urgent than in acute synovitis; the surrounding textures are less affected, and the swelling being confined to the affected texture, the diagnosis is more simple. The pain is of an aching character, and is felt principally on twisting the joint or on pressing over some part of the synovial sac; it is usually worst at night. In some instances there is very little effusion or swelling, merely a creaking sensation on movement of the joint. In other cases the effusion is well marked and persistent, constituting Hydrops Articuli.

The treatment is a modification of that employed for the acute disease. Blisters applied over the affected joint, the warm douche, and friction, are the means most likely to be beneficial. If the patient be of the rheumatic diathesis constitutional remedies are necessary.

LECTURE XXXVII.

Traumatic Inflammation of Joints: Symptoms; Progress; Methods of Treatment—Dry cold, or Ice Treatment—Anchylosis: Partial or Fibrous, Complete or Osseous—Conditions which render Anchylosis desirable—Modes of effecting it—Operations for separating Anchylosed parts when necessary—Resection—Hydrops articuli—Loose Cartilages in Joints: Symptoms; Treatment, Palliative and Radical.

In traumatic inflammation, arising when a joint is wounded by a puncture or incision, the local symptoms are not severe at first, and there is little or no constitutional disturbance. At the end of thirty-six or forty-eight hours, however, unless proper treatment be adopted, pain comes on and spreads over the joint, which soon presents a considerable amount of swelling and tension. The wound may ulcerate and break open, allowing some synovial fluid to escape, which so far relieves the tension; but the inflammation still proceeds, and general swelling of the limb occurs. This is accompanied or followed by great constitutional disturbance. The pulse rises in frequency, and becomes altered in character. Rigors of greater or less severity come on, and succeed each other rapidly, and the fever presents a truly irritative character. The secretion flowing from the wound becomes unhealthy and purulent, and abscesses begin to form in the cellular tissue around the joint and between the muscles. There is much excited action; but great debility present at the same time. In a great many of these cases the result is fatal; the irritative fever proceeds, and the patient dies with symptoms of acute pyæmia. Occasionally, however, the patient may struggle through and recover.

The old plan of treatment consisted in the application of warm fomentations and active depletion. These means may arrest the more acute symptoms, but they are seldom of much efficacy. There is a period of debility which must succeed in consequence of the character of the inflammation, and the thought of this deters us from depleting, even though it might soothe the immediate pain. Another mode of treatment consists in trying to alleviate the inflammatory action by such local measures as making incisions to relieve tension and opening abscesses when matter has formed in the joint. These measures, however, are often unsuccessful; and when a cure does result, it is always by anchylosis, and that only after great risk to life.

In treating a wounded joint, two objects are aimed at—To obtain primary union, and to prevent inflammation. With this view, local and general measures have been proposed, the former of which are the more important, and include rest, position, and the application of cold.

Suppose the case of a wound of the knee-joint. If the opening in the joint be small, it should be washed with carbolic or boracic acid lotion. A piece of lint, a little larger than the wound, soaked in boracic lotion should be laid over it and covered in by a layer of gutta-percha, the margins of which are made to adhere to the skin by touching them with chloroform, and this should be varnished over with lac varnish. The limb should then be slung in a splint, with the knee-joint nearly but not altogether straight, then a layer of gutta-percha tissue is laid over the joint and ice bags applied.

If the wound be large and the joint freely exposed, its cavity should be thoroughly syringed out with carbolic lotion (1 part to 40), the limb placed in position, and the edges of the wound united by two or three points of suture. Lint soaked in boracic acid lotion laid over the wound and covered in by gutta-percha tissue, as in the former case, and then cold applied; by this treatment carefully carried out the inflammatory process is limited, or altogether prevented, and in many cases the motions of the joint are preserved.

In wounds of joints, when we cannot depend upon a regular supply of ice, the antiseptic method may be used, as it seems to have answered well in these cases.

The employment of ice as the cooling agent is not a novel practice, but it is not so generally adopted as its merits appear to warrant. It is much to be preferred to irrigation with cold water, both because a *dry* cold is obtained, and a lower temperature produced, and because it can be much more easily and efficiently applied. With irrigation, the wound and surrounding skin are constantly kept in a sodden condition, so that primary union is frequently prevented, and a painful state of the skin often produced. Moreover, the patient is liable to catch cold, from an accidental wetting; for, in the case of the knee and ankle at least, it is almost impossible to confine the water within the trough. With ice, everything can be kept perfectly dry, by enclosing the ice in india-rubber or gutta-percha bags, and by adopting the additional precaution of covering the wound with a large sheet of the latter material, to prevent any accidental escape of water from reaching it. Were it even possible, however, to use irrigation without wetting the wound and surrounding skin, ice would nevertheless be preferable, on account of the lower temperature produced by it. When some of my cases were under treatment, the supply of ice several times became exhausted, and during these intervals the joints had to be kept cool by irrigation, which was never adequate to prevent a rise in temperature and an increase of pain. Re-application of ice always reduced the former and removed the latter.

The semi-anæsthesia produced by ice is generally sufficient to remove the pain until suppuration sets in; afterwards its influence in that respect is not so decided. In order, however, to keep the patient at perfect ease, the bag must be promptly re-filled as soon as the ice has melted; for, unless an equable low temperature be preserved, pain is not completely removed. In some cases it is even increased, and possibly this may, to some extent, explain the difficulty with which ice is borne by some patients of irritable temperament. The low temperature, so

far from being hostile to the nutrient changes requisite for primary union, is, through its power of preventing inflammation, one of the best aids to primary union that can be adopted. During the late campaign in Schleswig-Holstein, the surgeons of both armies applied ice to all wounded joints, and to nearly every stump after amputation; and the general conclusion arrived at was, that where it was employed, primary union was more frequent and more extensive, and that the ensuing suppuration was always less. These results ensued whether the ice was applied only until the commencement of inflammation, as practised by Langenbeck; or when it was kept applied until the wound had almost entirely healed by the second intention, as recommended by Esmarch. The practice of continuing the application of cold after inflammation has set in has generally been considered a dangerous one by the surgeons of this country; but, contrary to what might have been anticipated, the cases treated on the principles of Esmarch succeeded almost as well as those where Langenbeck's practice was adopted.

In patients who are of an unhealthy constitution, no method of treatment is sufficient in every case to prevent inflammation, even where the wound is incised and clean. In them the inflammation progresses rapidly, notwithstanding the local means used for subduing it. It would, however, be worth while to investigate, whether or not a lower temperature than that produced by ice might not advantageously be employed in some cases where the tendency to inflammation is unusually decided, either from constitutional peculiarity or the nature of the wound. We do not as yet know the lowest temperature at which a part of the body in a normal state may be kept by *dry* cold, without serious interference with its nutrition; still less do we know to what depth of temperature a wounded part may be safely lowered. Should it be found that a lower temperature than that produced by ice can be borne, its production could be effected without much difficulty by the employment of various frigorific mixtures, graduated according to the temperature required. These could without difficulty be prevented from coming in contact with the wound, by enclosing them in thick india-rubber bags, and by laying a sufficiently large sheet of the gutta-percha between the bag and the wounded part. In applying ice to a wound, common bladders ought never to be used if gutta-percha or india-rubber can be obtained, as they very soon allow the water to ooze through, and, notwithstanding the low temperature, soon undergo decomposition. Moreover, gutta-percha is cheaper, and bags can be made very easily by simply wetting the margins of the pieces to be joined together with chloroform, and holding them in apposition until they dry. In the removal of loose cartilages from the knee-joint, by subcutaneous or direct free incision, I have found that ice constantly applied to the part after the operation until all tendency to inflammation had ceased, was of great service in helping to ward off the serious consequences which have so frequently followed these operations.

If, after applying cold constantly to the part, we find that the disease progresses—if the joint continues to swell, and suppuration is threatened, we must first apply warm anodyne fomentations, and afterwards, if neces-

sary, make free incisions around the joint wherever matter has formed. Poultices should then be applied or folds of lint moistened with tepid solution of boracic acid or weak carbolic lotion, and the limb must be kept in a state of perfect repose. In these obstinate cases we generally find that there is some degree of ulceration in the cartilages of the joint.

When the suppuration is extensive, either in idiopathic or traumatic inflammation of a joint, we must look for a cure by anchylosis—that is, by a firm union, either osseous or fibrous, of the opposed surfaces of the bones. When we look at a joint where suppuration has occurred, and where the cartilage gradually sloughs off, we find the surfaces of the inflamed bones exposed. If these be allowed to strike against each other they become sources of increased irritation, and, therefore, of increased irritative fever; but if they be kept in accurate position with each other and at perfect rest, then new bone is thrown out from their opposed surfaces, by means of which they gradually unite. The vessels pass from the Haversian structure of the one part to that of the other, and the two bones become anchylosed, or, as it were, welded together, so as to form one. This may occur in either chronic or acute disease, and need not be despaired of even when the symptoms appear to be at the worst, and when all the textures seem to be disorganised from the amount of suppuration.

Anchylosis, as a result of injury or disease of a joint, may be either fibrous or osseous. Partial or fibrous anchylosis is comparatively common, and is most usually met with in cases in which the cure has been accomplished in the earlier stages of joint-disease. In such cases the osseous surfaces are not united, except perhaps at one or two points—sometimes not at all. This anchylosis results from shortening and thickening of the ligamentous textures, and adhesions between the fibrous texture, which takes the place of the cartilages on the articular surfaces, whilst the synovial sac is obliterated and the synovial membrane altered in structure.

True complete or osseous anchylosis, as already described, consists in osseous union of the articular ends of the bones forming the joint, which are then firmly welded together in a close unyielding mass as one bone. It occurs after injuries of joints or in cases of disease, where the cartilages have been rapidly absorbed and the exposed articular surfaces kept in apposition during the cure. Osseous anchylosis is considered by some to be a very rare occurrence; but though much less frequent than fibrous anchylosis, it is by no means uncommon. I have met with a great many cases in practice; and in my own private collection I have numerous specimens of very complete osseous anchylosis of almost every joint in the body, including the knee, hip, ankle, elbow, and vertebræ—the shoulder and wrist being the only joints of which I do not possess specimens.

Although in some respects anchylosis is considered a favourable result in cases of injury or disease of joints, as regards the cessation of the constitutional symptoms; and though in many cases our treatment is directed to procure this result; yet, unless under certain circumstances, anchylosis cannot be considered absolutely favourable, as it often leaves a useless, or worse than useless, limb. In injury or disease of the

knee-joint, for example, if by careful treatment we succeed in obtaining firm anchylosis in the straight position, then the result is favourable, as the limb, though not capable of performing all the natural movements, gradually becomes very useful. On the other hand, in cases where a joint becomes anchylosed at an inconvenient angle, the limb is rendered useless, and if it be the lower limb it is an encumbrance. In such cases the surgeon requires to interfere to remedy the deformity resulting from the anchylosis. In cases such as that of the elbow-joint, excision, removing considerable portions of the articular ends of the bones so as to form a new movable joint, is decidedly the proper treatment. If the operation be properly performed, and first passive and then gradually active motion be judiciously persisted in, the result will be exceedingly favourable, and the arm will become almost as useful as ever. In the lower extremity, however, say at the knee, a movable joint after excision does not prove useful, and hence the treatment is generally directed to obtain straightening of the limb, and a stiff joint. The methods of treatment adopted for this purpose are various. In cases where the deformity is recent, and the anchylosis fibrous, gradual extension by means of the screw-lever splint (fig. 2, plate xx.), or the wire-splint gradually straightened, either with or without division of any contracted tendons, will generally prove sufficient, and if the disease has not been extensive, some of the natural motions of the joint may even be restored. In cases of firm osseous anchylosis such treatment would be useless. Hitherto the methods generally adopted have been either to break up the anchylosis by forcible extension, after division of contracted tendons, or to perform resection by removing a wedge-shaped portion of the anchylosed bones, so as to enable us to place the parts in the straight position, the after-treatment being the same as after excision of the knee.

I have in several cases had recourse to the former method successfully, but it is excessively rough surgery, and not unattended by danger. We must recollect that if there has been much irritation of surrounding tissues, the great vessels behind the knee-joint may have become locally diseased. At all events they, as well as the tendons, have become contracted and adherent, accommodating themselves to the new position of parts. Hence their coats may suffer from the sudden forcible extension necessary to break up the anchylosis. This is no imaginary danger, for I have known of subacute gangrene following such extension. Again, in young persons, instead of the osseous union breaking up, the force often separates the epiphysis of the tibia, and the limb, though straightened, remains somewhat deformed. The resection of a wedge-shaped portion of the anchylosed bones, though free from the dangers alluded to, is a serious operation, being a form of excision of the knee-joint.

Dr. Gross of Philadelphia, the son of Professor Gross of that city, employs a procedure which, in suitable cases, is both simple and efficient. Instead of forcibly breaking up the anchylosed knee-joint, he makes a subcutaneous incision, and then, by means of a drill, cuts through the osseous union so far that the remainder yields to very slight force. The incision is then closed, and the limb treated in the straight posi-

tion, division of contracted tendons being had recourse to if necessary. I can understand many cases in which it would be difficult to carry out this plan; but certainly the drilling operation, combined if necessary with the use of a fine saw, is in my opinion much preferable to forcible extension.

Of course, in all cases of anchylosed knee-joint, neither forcible extension nor Dr. Gross's method is permissible or warrantable until all diseased action has ceased for some time. To interfere when there is pain in the joint, or shortly after active disease has been arrested, would be simply to re-excite it under very unfavourable conditions. The proper treatment under such circumstances is resection of a wedge-shaped portion of the bones including the disease.

HYDROPS ARTICULI, or dropsy of the joint, is another morbid condition which sometimes results from inflammation of the synovial membrane, although it is said occasionally to arise independently of such action. The effusion which is thrown out continues, the synovial fluid is more serous than natural, and the whole joint is distended. There is not much pain, however, because the ligamentous and other textures have yielded gradually, and are passively distended by the increasing quantity of the fluid. The amount of secretion varies; at times undergoing absorption when the patient is quiet, and rapidly accumulating again under any irritation. This condition of the joint is very troublesome. Sometimes it is simply the part of the synovial sac under the aponeurosis of the quadriceps extensor which has become distended. The movements of the limb are not then so much interfered with. When, however, the disease has existed for any length of time, the whole articular cavity becomes distended, and disorganisation of a slow character takes place.

The first thing to be aimed at in the treatment of this disease is to get rid of the chronic effusion. One cause of the dropsy probably is effusion from the congested vessels. This takes place very rapidly, and is prevented from being absorbed by the thickening and altered condition of the synovial membrane. To meet these conditions we apply blisters over the affected joint. We also give internal remedies, such as iodine or mercury. These serve to cause disintegration and absorption, and excite a more healthy action; or according to the old notion, restore the balance between the exhalants and the absorbents. The limb must of course be kept at perfect rest, and should also be bandaged from the foot or hand upwards, which further helps the process of absorption. In many cases the tendency to the return of the effusion is very great, the disease being cured for the time only. When this treatment fails to cure the disease effectually, we must then adopt more active measures. We must tap the joint and inject iodine into it, as in hydrocele. This mode of treatment, however, is not unattended with a considerable amount of danger. In many cases no bad symptoms may follow; but in others, violent inflammation and suppuration are the result. When we simply puncture the joint and draw off the fluid, the danger is perhaps greater than when we also inject iodine. The iodine excites a healthy form of inflammation, and prevents the formation of purulent matter in the synovial sac. It seems to possess an

antipyogenic power. In the slighter cases we are not warranted in having recourse to this treatment, but only in such as have resisted the ordinary measures. Internal remedies are also to be given, and the state of the constitution attended to.

Movable Cartilages in Joints are met with occasionally. The general symptoms are very similar to those of subacute or chronic synovitis. There is pain, with more or less fluid swelling of the joint. When the knee is affected, the patient probably at first experiences in walking or in taking a sudden step, a feeling of excessive pain in the joint. This is sometimes so severe as to cause him to fall. This symptom is due to the loose cartilage having slipped between the condyles of the femur and the head of the tibia. In other cases the pain is not so marked; but the patient can generally tell when the cartilage gets between the ends of the bones. When the joint is much swollen and distended with fluid, it is not always easy to make out the presence of the loose cartilage, especially if it be small and flat. Should there be any difficulty, it is best to keep the patient quiet for a few days until some of the effusion has become absorbed, and then examine the joint. The cartilage may be either completely loose, or fixed by a long narrow pedicle. If it be quite loose, it will be felt sometimes at one side of the joint, sometimes at the other; at one time above the condyles of the femur, at another over the head of the tibia. The patient can generally find out the position of the cartilage sooner than the surgeon can, from the sensation which he has of its position. When the cartilage is small it is sometimes very difficult to ascertain its presence.

There is another disease which may be mistaken for loose cartilage. I refer to disorganisation of a slow character in the knee-joint, leading to destruction of the attachments of the semilunar cartilages. These cartilages, when so loosened, glide backwards and forwards, and catch the patient while walking. Hence the symptoms are almost identical with those of the ordinary movable cartilage; but the treatment, as we shall see, is different.

The Treatment of movable cartilages is either palliative or radical. The former consists in bandaging the limb, and applying means of retention, such as the laced knee-cap with pads, to fix the joint and prevent the cartilage from getting in between the ends of the bones. When so protected the patient can generally go about in comparative comfort, and without any swelling of the knee taking place. The radical treatment consists in removing the loose cartilage, either by a free incision made upon it through the skin, fascial and synovial textures, or by subcutaneous incision. In the latter method, a tenotomy knife is introduced some distance from where the cartilage is held firmly fixed, then the edge is turned so as to cut down upon the loose cartilage. The cellular tissue in its neighbourhood is separated so as to make a sort of cavity into which the cartilage can be carried. It is left there, and the wound closed. If the cartilage afterwards give rise to any irritation, it can be cut down upon and removed from the cavity in the cellular tissue. If not, it is left alone. Some apply blisters over it, so as to cause consolidation. This method of operating always

seemed to me to be incomplete. What good does it do to leave the cartilage in the cellular tissue? Why not extract it completely when cutting down upon it? The plan of cutting down upon the cartilage and removing it has no disadvantages which the other has not, and is much simpler. With due care no air can enter the wound, and no source of irritation is left, and I have repeatedly operated in this last mentioned way with success. At the same time, there is no class of operations that I have a greater dread of than the apparently simple one of removing a loose cartilage. The case may go on most favourably, and then, when the patient is almost well, inflammation and suppuration may set in. Mr. Liston, I know, had a great dislike to such operations; he always recommended the palliative treatment instead. The operation itself is a very simple one; but still I would always try the palliative method before removing the cartilage. In the subcutaneous method of operating we must be sure that the cartilage is quite loose and not attached by a pedicle.

In the affection of the semilunar cartilages before mentioned, the palliative treatment, by fixing the joint and giving rest, is the only one that can be had recourse to; and in many cases of movable cartilage also, the palliative treatment is perhaps the best.

LECTURE XXXVIII.

Diseases of Joints continued—Chronic Strumous Disease or Gelatinous Degeneration. Frequency during the period of Youth. Mildness of its Earlier compared with its Later Symptoms. Local and Constitutional effects. Its general Pathology and Treatment. Its Complications, and the considerations which should influence our Treatment in connection with them.

The term White Swelling was formerly used to express all joint-diseases of a chronic character. It is now understood to denote a constitutional form of disease affecting the synovial membranes, to which we give the name of Gelatinous Degeneration, or Fungus Articuli. This diseased condition occurs almost always in the young; seldom, if ever, for the first time, above middle age. In those cases, therefore, where it does occur in advanced life, we generally find that there has been a similar attack in early youth. The disease may assume the chronic character from the very commencement, in which case its onset is very insidious, and the symptoms are slight and vague. Or it may follow immediately on an acute attack, in which case the symptoms undergo a marked alteration in character. The swelling becomes less diffuse and more bulging; and, although elastic, becomes gradually more boggy to the feel. The pain becomes greatly diminished, and the symptomatic fever gradually lessens.

Gelatinous Degeneration may attack any joint in the body, but those most frequently affected by it are the knee, the elbow (plate xiii. fig. 5), and ankle. I shall therefore take the knee-joint as an illustration, and the low chronic form of the disease, as it is by far the most common.

For the first month or so the patient occasionally complains of a very slight degree of pain or uneasiness; he is a little lame, or rather awkward in his gait, from an instinctive desire to save the limb. The pain gradually increases, especially towards night, and becomes more distinctly localised, the patient generally referring it to one particular spot in the joint. At length we are consulted for its relief, and on examination—say six weeks after the commencement of the disease—we find a partial swelling on either side of the patella, and extending towards the posterior aspect of the lateral ligaments. This increases around the patella, and the markings of the bone are gradually lost in it. The swelling presents either a peculiar elastic or a doughy feeling. The enlargement seems greater than it really is, owing to the emaciation of the limb, for even at an early stage of the disease the thigh and leg of the affected limb become perceptibly atrophied.

As the disease goes on, the symptoms become more marked. The colourless swelling increases, the joint becomes more tense and has a

glazed appearance. The patella is somewhat raised, though not so much as in synovitis, and the general appearance of the joint bears a close resemblance to what we see in that disease. The pain is not aggravated by pressure on the part; but movement of the limb causes an increase of it, more especially if in doing so the articular surfaces are pressed against each other. The lateral ligaments after a time yield, the swelling becomes more general than in synovitis, and the surface is marked by superficial veins which become prominently enlarged and conspicuous. The whole joint becomes altered in consequence of disorganisation of its fibrous textures, and the limb becomes rapidly atrophied. As the disease advances, abscesses begin to form in the surrounding parts, and then pain, sometimes severe, is felt in the swollen joint itself. At a further stage of the disease the pain in the joint becomes very acute, and different in character. At night it becomes extreme, and there are spasms and startings in the limb, from an uncontrollable convulsive movement of the muscles, so that the patient cannot sleep. Thus his strength becomes exhausted, his appetite fails, his general health breaks down, and severe irritative fever, tending towards hectic, sets in. The acute pain at night, together with the spasms, are met with in another affection of the joints—namely, in acute ulceration of the cartilages; but in that disease they occur at a much earlier stage of its progress.

The pathological condition leading to these symptoms consists in a peculiar degeneration of the synovial membrane. This exists under two forms, and these have been described under two separate names—the gelatinous and pulpy degeneration—but they are truly identical in symptoms, and as regards the essential nature and course of the disease. In the gelatinous degeneration as first specially described by Sir B. Brodie, all the cartilages of incrustation become gradually covered over by masses of new deposition, which extend wherever there is synovial membrane. In the recent state this deposit has a gluey or jelly-like character, varying in colour from pale yellow to dark brown, and is generally intersected by lines of a white membranous structure. This is the more usual character of gelatinous disease, but there is another condition, in which the membrane assumes a sort of granular or fungoid appearance on the surface; this has been described as pulpy degeneration: but all the phenomena are the same as in the former case, and there is no use in making a distinction between the two conditions. The deposit fills up the whole joint, and acts as a kind of soft cushion, protecting the ends of the bones, so that at first, when the swelling is most marked, there is comparatively little pain. As the disease goes on, however, it leads to a low form of suppuration in the surrounding textures, and induces irritative fever. While the suppuration progresses, we find other changes taking place. The cartilage begins to undergo absorption, either from the pressure of the new deposit upon its surface, or from a peculiar action which the deposited substance exerts upon it. The absorption arises chiefly, I believe, from the pressure on the surface of the cartilage leading to its ulceration and exfoliation, and we can thus easily understand why it is that in the later stages of gelatinous degeneration we meet with symptoms exactly like those of acute ulceration of cartilage. In both cases, the cartilage

of incrustation is separated, and the opposite surfaces of the inflamed bones come into contact with each other, giving rise to pain, and starting whenever the opposed surfaces touch one another. It is, in fact, really ulceration of the cartilage, but arising in a different way from what is generally understood by that term. In gelatinous degeneration of a joint, all the textures are ultimately involved; not only the synovial membrane and the cartilage, but also the fibrous textures and the cellular tissue. This gives rise to disorganisation and the formation of abscesses and sinuses in all directions (plate xi. fig. 4).

The atrophy of the muscles may arise either from disuse of the limb or from some peculiar change in its muscular texture. At one time the former view was held, but in a great many cases of synovial and other diseases of joints we find that the limb affected is always atrophied, and that when the diseased condition is so far got rid of, and the patient able to move about, whilst the healthy limb regains its normal state, the affected one never does so completely. This is due to the fact that the muscles of the affected limb have undergone a fatty degeneration, so that the atrophy arises partly at least from a positive alteration in the structure of the muscles. Although the joint usually affected is the knee, yet the disease is not uncommon in the ankle and elbow. The ankle-joint is that in which I would have most hesitation in having recourse to operative procedure, because I have seen many remarkable recoveries from disease of this joint in young children, even where suppuration and ulceration had taken place. In the elbow gelatinous degeneration also occurs frequently, but I cannot recollect of having seen a case of this synovial degeneration in the shoulder-joint.

We now come to consider the *Treatment* of gelatinous degeneration. At one time the disease was considered incurable. Sir Benjamin Brodie held that it was the most incurable of all joint-diseases, and that, sooner or later, the patient either had to undergo amputation or died. On the other hand, Mr. Scott affirmed that the disease was always curable by his plan of treatment, which consisted principally in rest and graduated pressure on the joint by plasters, together with proper nutrition. The truth lies between these two extreme statements. A very large proportion of cases, especially where the disease is situated in the knee-joint, require amputation or excision sooner or later; but at the same time it is equally true that many cases can be cured by milder measures, if we see them at an early period, and if the patient can be kept under treatment for a sufficient length of time. And so it happens, that in the upper classes we do not so frequently require to perform amputation for gelatinous disease, as we have to do in hospital practice where the patient cannot be kept long enough under treatment. A patient not unfrequently is dismissed from hospital cured, but owing to his poverty he is obliged to return to his work. By too early and frequent use of the limb, and insufficient nutrition, too great a strain is put upon an originally feeble constitution, and so the disease is reproduced.

In the treatment of this disease, rest is indispensable in every stage. The limb should be placed in the position in which it will be most

useful to the patient afterwards. In the lower extremity the limb is kept perfectly straight, or nearly so. If it be partially bent, it should be put up in a wire splint, so formed as to suit the angle of the limb; then, by gradually straightening the splint and the knee together, we bring the latter straight by degrees. If the swelling be white and colourless, as it generally is, we must examine to see whether there be any heat of skin, for the inflammation is deep-seated, and there may be no redness on the surface. If we find that the temperature is greater than that of the corresponding healthy joint, then we must apply tepid solutions of acetate of lead, and morphia, to allay the irritation. This treatment should be kept up for some time; the limb being at the same time bandaged from the foot upwards, and thin strips of lint or cotton, soaked in the solution, brought over the knee-joint, in the form of a many-tailed bandage, so as to give support to and exert a moderate degree of pressure on the joint. This pressure may be increased from time to time as the patient can bear it without much pain, but if it be not done gradually, it will give rise to an increase of the excited action.

In gelatinous degeneration a certain amount of synovial effusion may be present, and we may be tempted to apply a blister at an early stage to cause absorption, but it is very likely to excite too much action, and do harm. A blister should not be applied till the increased temperature has become reduced, but after that it may be of considerable service. When the blister has healed, support by bandaging should be resumed, and occasionally the surface may be painted over with iodine, in order to keep up gently the deobstruent action. Subsequently we may begin what is called the plaster-treatment, which was first adopted by Mr. Scott. This consists in bandaging from the foot upwards to near the knee, as we have already indicated, and then applying broad strips of adhesive plaster round the joint. The ends of the plaster should be made to cross over the joint for some distance, and each layer made to overlap the preceding one to two-thirds of its width. The plasters should be made to extend well up the thigh, and then the bandage from the leg continued upwards over it. The limb is then slung in a splint, and the plaster left on for a few weeks without being removed. In some cases, medicated plasters, such as the Emplastrum ammoniacum cum hydrargyro, are used, but I have found that the irritation of the skin produced by them is often so great as to excite too much action, causing vesications on the limb, and hence leading to its being disturbed too soon. I therefore prefer the simple adhesive plaster, which is generally quite sufficient to stimulate to absorption of the exudation, though in some cases of a more chronic character the medicated plasters may be useful. By keeping the limb at perfect rest in the above way, by giving nourishing diet, and by attending to the patient's general health, we may, in a very large proportion of cases, get rid of the diseased condition, but great care must be taken that the affected limb be not used for some time. Should abscesses form about the joint, they must be evacuated in the manner advised for opening chronic abscesses.

In the upper extremity, at a comparatively early stage of synovial

disease, the question of excision of the joint comes before us, and this is often the best method of treatment; for an anchylosed joint in the upper extremity leaves a comparatively useless arm—certainly a much less useful one than remains after the joint has been excised. In the arm we can get rid of all the diseased parts without much shock to the patient's general health. In the knee-joint also it is well not to wait too long before operating, for when abscesses begin to form round the joint, the case is less favourable; and so, when there is much disorganisation of the articular textures, we operate before the patient's health has suffered much. I believe that most cases of gelatinous degeneration in the knee are not well suited for excision. The operation does not seem to me to answer so well here as in some diseases of the articular ends of the bones; in most cases the general health of the patient is not so well suited for the operation, which requires considerable strength and involves a long period of convalescence. Moreover, I have found that even cases where excision of the elbow or wrist joints has been performed for gelatinous disease never go on so favourably as cases where the operation has been performed for what looks like more extensive disease. This form of diseased action seems to be of a low type, and connected with a very marked strumous diathesis, and the curative process seems to be very slow; hence, besides the risks of pyæmia incidental to all operations in debilitated constitutions, it is often complicated with pre-existing disease of other organs, or a predisposition to diseased conditions, which are very liable to develop themselves during the progress of the disease, or after operations, such as excision or amputation performed for its removal.

The complications most frequently met with are—disease of the lungs, kidneys, and occasionally, though much more rarely, disease of the membranes of the brain, or tubercle in the brain-substance. In drawing attention to such complications, I do not mention them as contraindicating operative procedure, but because I believe that by careful attention to the state of such patients, we may often be enabled to check the development of some of the conditions mentioned, when they arise during the after-treatment of cases which have been operated on. Again, by careful examination of the general health of such patients, we will often, by delaying operation and preparing them, give our operations a better chance of success; and we will also be guided as to the nature of the operation to be performed—as, for example, in deciding between excision or amputation. In regard to disease of the lungs, unless the disease be far advanced, we ought, as a general rule, to operate. I believe that the joint-disease is a source of great irritation and debility, and that by amputation or excision we relieve the patient of a diseased condition, procure rest, allow nutrition to be carried on, and so arrest, or at least paliate, the lung-disease. I have so frequently seen consumptive patients, who were suffering from gelatinous degeneration of the knee, regain strength and flesh, with marked amelioration of the chest-symptoms, after an operation, that, as I have said, unless the disease be very far advanced, I never hesitate to give the patient the chance; and the recoveries in such cases from the operation are usually very rapid. As to the dread which

formerly existed, that the local disease acted as a sort of counter-irritant, and that its removal would be followed by more rapid development of the disease of the lungs, I can only say, that after a very considerable experience in such cases, I have always found amputation followed by amelioration, not exacerbation, of the chest-affection. I recollect one patient, a man who had suffered from tubercular phthisis for several years, who came under my care; he had cavities in the apices of both lungs, and occasional smart hæmoptysis. Besides examining the chest myself I had him carefully examined by the physicians of the hospital, who agreed with me in thinking that the advanced stage of the chest-disease, and his extreme debility, contraindicated operation, and I declined to accede to his request to amputate the limb. He left, and went to another hospital near his home, where he induced the surgeon to take off his limb; and eight months afterwards he presented himself to me, looking in pretty good condition, and, as he said, with less cough and spitting of blood; and he lived for two or three years afterwards, showing how much relief may be afforded, even under unfavourable circumstances, by removal of a painful and debilitating local affection. It is necessary, however, to remember that, notwithstanding the advantages which often result to consumptive patients suffering from gelatinous disease, still there are many cases in which it would be wrong to amputate the limb or excise the joint, unless the patient's health be pretty good, so as to bear the protracted after-treatment.

The diseased condition, however, of which I have greatest dread in connection with gelatinous degeneration, is one which is also to be met with in certain forms of scrofulous necrosis, but I have specially noted it in relation to gelatinous degeneration. I allude to disease of the kidneys, and as it is a complication which may not attract attention till too late, I would seek to impress you with the necessity for great care, not only in the examination of patients prior to operations but during the progress of the after-treatment. Not unfrequently all seems going on well, the wound heals, and perhaps the only suspicious sign noticeable is that the pulse does not come down in frequency, or at least is variable. Some weeks after, when the patient seems convalescent, the appetite begins to fail, and a little irritation and swelling arises in the part operated on, which was healed, or all but healed. The parts are œdematous, and the lower limbs are also in the same condition. The urine is probably now examined, and on being tested is found highly albuminous, and the case soon terminates fatally.

I have long made it a rule, when a patient of marked strumous diathesis comes under my care with joint-disease, or disease of bone, to test the urine, and to have it tested from time to time, at least every second or third day, both prior to the operation and during after-treatment; for often, where there is no trace of albumen or unhealthy condition of the urine at first, these conditions may afterwards develop themselves rather suddenly. There are, however, other symptoms in such cases, which, if attended to, indicate I think this tendency; at least, from my own observation, I am always very suspicious when the skin is dry and harsh to the feel, the pulse quick or variable. Very specially when, during the treatment of such cases, we notice the tongue

to be red and glazed, or worse, if it presents the appearance as if little patches of the epithelium had peeled off, ought we to dread the occurrence of renal disease. I have so frequently seen cases in which the urine was healthy, so far as the evidence of tests was concerned, but in which, after a few days a form of subacute albuminuria occurred, with ultimately fatal results, that I cannot forbear dwelling, it may appear tediously, on this subject, because I believe careful treatment might at first obviate this condition, or prevent it from progressing if early looked for and detected.

In such cases the diseased condition of the kidney is generally found to be either the amyloid degeneration or an acute congested state of the organ—the latter state probably supervening rapidly in an organ predisposed to disease. The state of the urine in the latter case is somewhat peculiar—its specific density often remaining normal 1020, whilst it is highly coagulable. From what I have seen of cases in which this complication has arisen, I believe if the condition be suspected and detected early, that, by the use of sinapisms, or cataplasms containing mustard, the exhibition of mild diluent diuretics, and the use of farinaceous instead of more stimulating diet for a short time, the acute or subacute congestion of the kidneys may be arrested. This will be shown by the subsidence of œdema, the diminution of albumen in the urine, and by the tongue resuming its normal appearance. In some cases, at the very commencement of this condition, I have occasionally found benefit from the use of small eliminative doses of colchicum wine; and in all cases the use of diaphoretics, to cause a moderate increase of the cutaneous transpiration, are of great use in relieving the irritation of the kidney. After a short time, if the œdema continue, the use of the muriated tincture of iron, combined with nitrous æther, will be found the most efficacious remedy. If, however, the diseased action has gained head before being noticed, the result is almost always fatal. Whilst this tendency to renal disease is met with in cases after amputation, I think that it is still more likely to be developed after operations, such as excision of the knee, where the after-treatment is protracted; and, as I have said, I have even seen it occur after excision of the elbow in cases of gelatinous degeneration. I confess that this consideration would weigh with me in deciding between amputation and excision.

As regards the general treatment of Gelatinous Degeneration, chalybeates, which are of use in all scrofulous diseases, are especially useful here, and cod-liver oil is one of the best nutrients in this form of disease. It requires much care and experience to know when to give stimulants, and when to avoid them, during certain stages of the diseased action. When it is assuming a subacute type, before suppuration has begun, then stimulants are injurious; but when suppuration has commenced, or when the irritative fever is considerable, the use of stimulants is distinctly indicated.

LECTURE XXXIX.

Ulceration of Cartilage—The Characters, Symptoms, Progress, and Pathology of the Disease—Distinctions between Ulceration of Articular Cartilage and Gelatinous Degeneration—Primary and Secondary Affections of Cartilage : Danger of confounding them with Disease of Osseous Textures—Aids to Diagnosis—Morbus Coxarius : its Manifestations, Progress, Diagnosis, and Pathology.

THE cartilage of incrustation, although an organised structure, is endowed with but feeble vitality, and is thus all the more liable to become affected by disease. It is of a firm, durable consistence, by which property it is well fitted to protect the articular surfaces from the tear and wear of ordinary action. It has an elasticity which adapts it for meeting the contingencies arising from concussion, and its surface is smoothly polished so as to lessen friction and ease the motions of the joint. In its intimate structure it is destitute of nerves and blood-vessels, and it therefore possesses little vitality and no sensibility. Thus, it is admirably adapted for its functions, which are chiefly of a protective kind, and for which the simple qualities of resistance and endurance are mainly requisite. What little nutrition is required for the maintenance of such a low type of structure, the cartilage derives second-hand by imbibition from the tissues in its neighbourhood; and on the integrity of these, therefore, does its soundness depend, so that when they are involved in disease the cartilage is apt to become implicated secondarily. Sometimes, however, the cartilage is the seat of the primary affection, when it becomes diseased independently of the neighbouring textures.

Ulceration of the cartilage was described as a special form of disease by Sir Benjamin Brodie, though it was formerly known by the general term of white swelling, one of the stages of which it was supposed to be. Brodie pointed out that there were marked differences in the symptomatology of the two diseases in the earlier stages—the one being characterised by pain on being pressed in certain directions, while the other is painless; and the one being generally marked by a greater amount of swelling than the other.

Any joint may be affected by this disease, but those most commonly attacked are the hip, knee, shoulder, and elbow joints. The ankle is sometimes affected with it, but not so often as with gelatinous degeneration. One difference between this disease and gelatinous degeneration is, that in the former the patient feels pain and uneasiness at night at a very early period, leading to want of sleep and startings in the limb. The pain is generally of a sub-acute character, and the patient instinctively avoids resting any weight upon the limb. The nature and

locality of the disease may be often ascertained by the attitude the patient assumes. When the hip-joint is affected he bends the knee somewhat, and rests upon the opposite limb. When the knee-joint is the seat of disease, the limb is always bent, the thigh being flexed upon the pelvis, and the leg upon the femur, so that the articular surfaces of the bones are separated, and prevented from pressing against each other.

In the very early stage of ulceration of cartilage there is not much swelling, though even then there may be some effusion into the joint, and there may be a certain amount of irritation from affection of the synovial membrane. As a rule this is not the case as it is in gelatinous degeneration, and if there be any swelling it is noticed in the ends of the bones, the markings of which are not lost as in other joint-diseases. In the case of the knee-joint the head of the tibia appears larger than usual, and all the bones concerned are enlarged to a certain extent. This enlargement appears to be greater than it really is, owing to the atrophy of the muscles, and these become atrophied at a very early period.

In this, as in the foregoing disease, we shall take the knee-joint as an example. On examining the joint, if we press on either side of the patella, we produce no pain; the patient says he feels little or no uneasiness during the greater part of the day, provided that the limb be kept at rest, but that uneasiness and pain are experienced at night after becoming warm in bed, and sometimes during the day immediately after taking food. These pains, at first of a dull rheumatic kind, become after a time more persistent and acute, and the knee becomes gradually more and more bent, owing to the efforts on the part of the patient to avoid making any pressure on the articular surfaces of the bones. The pain is accompanied or followed by swelling of a subacute inflammatory form; at first within, but ultimately around, the joint. Unhealthy strumous abscesses form in the neighbourhood, which may afterwards communicate with the articular cavity. In the secondary stage the pain is not only intense, but is more or less continuous, and is increased on moving the limb or applying the slightest degree of pressure, and then the symptoms come on which are peculiar to the disease. Whenever the patient goes to bed and begins to fall asleep, he is roused by a sudden and convulsive jerking of the limb. This destroys his rest for the greater part of the night; but towards morning he doses over into an apparently tranquil slumber, from which, when he awakes, instead of being refreshed he is much exhausted. Under this extended ordeal of suffering his general health rapidly gives way, and he is reduced to the extremity of weakness and emaciation.

Sir Benjamin Brodie showed that these symptoms corresponded to those of the third stage of gelatinous degeneration, when absorption of the cartilages takes place. The jerkings of the limb arise in consequence of the contact between the exposed surfaces of the diseased bones. In ulceration of cartilage, as we have shown, these symptoms come on at a much earlier period than in gelatinous degeneration. The symptoms of ulceration of cartilage are so severe, in contrast with those of the

earlier stages of gelatinous degeneration, that we would conclude the extreme pain to be due to the affection of the cartilage itself. This idea, however, is opposed to what we know of the intimate structure of cartilage, which possesses no nerves or vessels in its texture. How, then, is the disease attended with such extreme pain? It has been shown that cartilage suffers from inflammation indirectly.

We find that, when cartilage undergoes alteration and absorption, the process may occur in two ways. It may commence within the cartilage itself, and then it takes place more or less slowly. The cartilage breaks down and its place is taken by a soft fibrous texture which covers the ends of the bones, and this is effected without much pain—just what we might naturally expect from the nature of cartilage. Thus true ulceration of cartilage is not necessarily connected with disease of bone, but the diseased condition generally spoken of as acute ulceration of cartilage I believe to belong to another texture altogether; it is, in fact, one of the symptoms of scrofulous inflammation of the articular ends of the bones, leading to articular caries. The articular ends of the bones are very vascular, and the cartilage is nourished from them; hence, in the earlier stages of the disease, we have swelling of the ends of the bones. There is no pain produced by making lateral pressure, but intense pain is experienced when we apply force directly upon the opposed surfaces of the bones, even though they are still covered by cartilage, because the bone underlying the cartilage is affected with a low subacute form of inflammation. The patient does not complain of much pain in the earlier stage of the disease, but then he keeps the joint bent, and the opposed surfaces of the affected bones as far away from each other as possible, so as to prevent their contact. As the disease goes on—as the ends of the bones inflame—the swelling of the joint becomes more marked, and the atrophy of the muscles becomes more evident. This corresponds to the period when the disease is at its worst. There is extreme excited action, and pain, and suppuration within the joint, and then the startings of the limb are induced, because, in many of these cases, the cartilage is thrown off in large exfoliations.

This I believe to be the true pathology of what is termed ulceration of cartilage; it is a disease not commencing in the cartilage itself, but that structure becomes affected from its connection with the bone. A low form of inflammation of the bone takes place, and exudation is gradually thrown out between it and the cartilage. The nutrition of the cartilage is thus interrupted, and at last it ulcerates and exfoliates. Subsequently when the opposed surfaces of the inflamed bones come into contact, excruciating pain is the result.

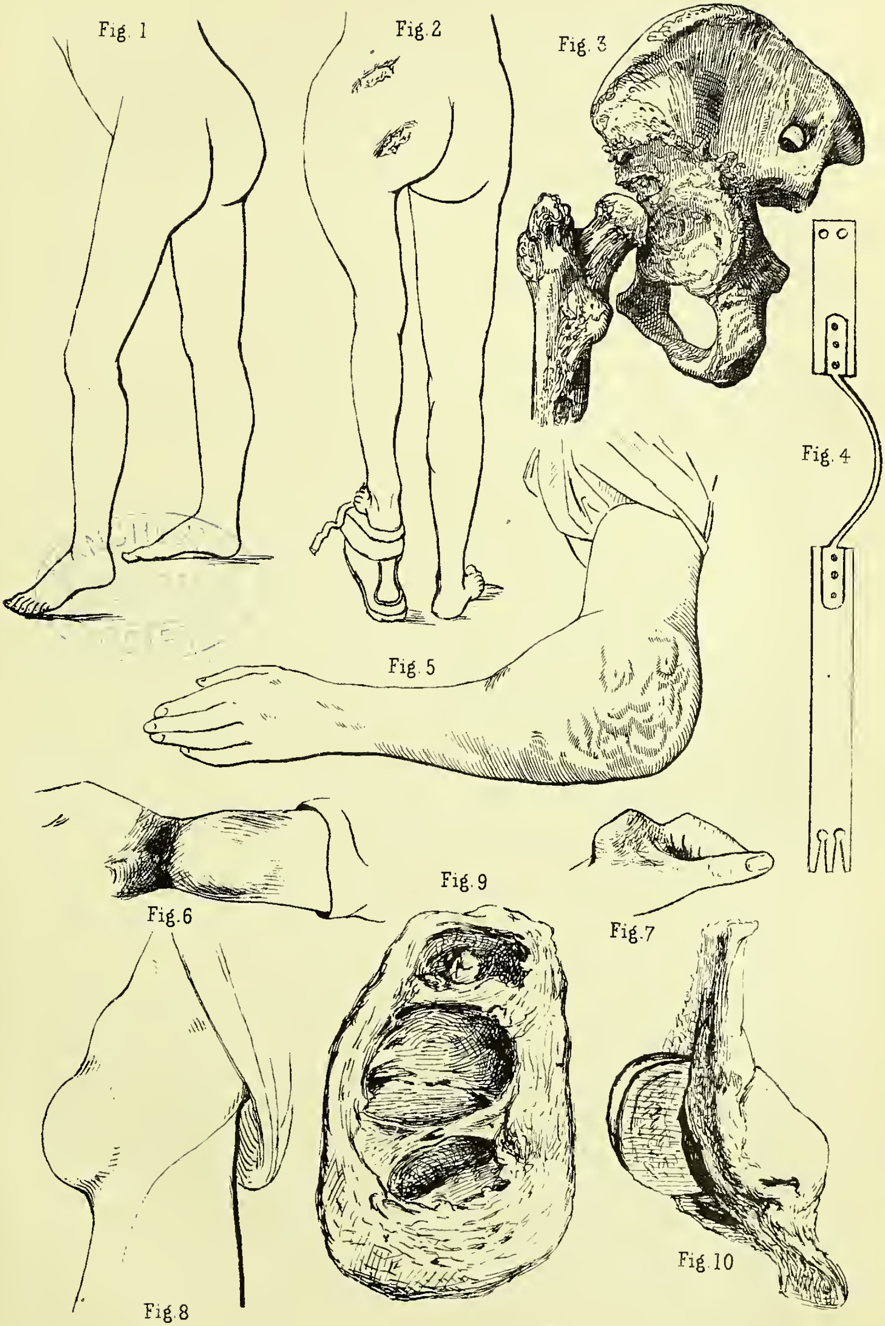
We see, therefore, that ulceration of cartilage may take place in two ways: either spontaneously, from changes within itself, in which case it is attended with no pain; or it may arise adventitiously, from inflammation of the bone beneath it, and then it is attended with acute pain. In the former case the disease progresses slowly, but in the latter the ulceration goes on rapidly. The pain in ulceration of cartilage, as distinguished from that in gelatinous degeneration, is almost invariably dependent on disease or change in the osseous struc-

ture, leading to ulceration or exfoliation of the cartilage, and so causing exposure of the inflamed bones (plate xi. fig. 3.)

As an example, let us take MORBUS COXARIUS, or disease of the hip-joint. This disease almost always occurs before the age of thirty, generally in early childhood. It may pass off at that time and then recur when the patient is advanced in life. On examining the patient we find that, on the affected side, the limb is somewhat everted, and that the fold of the nates passes obliquely downwards, giving the hip a flattened appearance (plate xiii. fig. 1.) The patient stands with the knee projecting forwards, and with the body stooping somewhat, so that the affected limb looks longer than the other. There may be some slight real lengthening of the limb, but the apparent lengthening is generally due to loss of power in the muscles, by reason of which they allow the hip to droop. It may also be, in part, due to the position which the patient instinctively assumes in order to prevent the head of the femur touching the acetabulum. The patient experiences little pain, except at night, or when walking. At these times he feels pain, not in the hip itself, but on the inner side of the knee. This pain is very often of an intense character, so much so that, in a great many cases of hip-joint disease, we find that the patient has been treated for disease of the knee, by blisters, warm fomentations, splints, and the cautery. If we touch the knee the patient complains of pain; but if the femur be fixed, and then the heel pressed upon, so as to cause pressure on the knee-joint, there is little uneasiness produced. The pain is neuralgic in its character, and sometimes extends to the outer side of the joint, but generally resides in the filaments of nerves on the inner side. If there be swelling about the knee it may be somewhat difficult to tell whether or not that joint is itself affected with disease; but on viewing the hip we can readily perceive that the disease is situated there, from the peculiar atrophied and flattened appearance of the nates. If the limb be rotated outwards, some slight pain is felt, so also when the limb is flexed; but if we press directly inwards upon the trochanter, and rotate the foot, the patient complains of excessive pain, which becomes greater as the pressure is increased, and this pain is felt even at an early stage of the disease.

The joint is affected by a low form of strumous inflammation of bone, leading to scrofulous caries, and this condition exists for some time without the cartilage being thrown off. Gradually, however, the patient goes on from bad to worse: the limb, instead of being longer than the other, becomes shortened, though this may not be very noticeable at first. Abscesses may form round the hip, either at an early stage or not until the last stage. The limb is sometimes much bent and drawn up, and the foot turned in. There is a slight projection of the trochanter major and an atrophied appearance of the hip behind. The shortening of the limb increases (plate xiii. fig. 2,) and sometimes the thigh is flexed at nearly a right angle with the body. These changes go on till dislocation of the head of the bone occurs. In the later stages we find the inflammation taking place in the surrounding textures; abscesses form in the neighbourhood of the hip, which require to be opened (plate xiii. fig. 2). Great irritation arises in front

Plate XIII



of the limb, and in some cases it is attended with enlargement of the glands. Abscesses sometimes form in the perineum, which may burst through into the rectum, or in the female, into the vagina. The general health of the patient is of course much deranged from the irritative and hectic fever accompanying the disease.

In the first stage there is simply the atrophy of the muscles, and a low form of inflammation in the acetabulum and head of the femur. The cartilages on both surfaces of bone are for a time unaffected. They remain as a protection, to a certain extent, until the diseased action in the bone leads to their ulceration and exfoliation. Coincidently with that occurs suppuration within and around the joint. The changes which the bone undergoes lead to dislocation. We may have a positive dislocation of the head of the femur on the dorsum of the ilium as a consequence of disorganisation of the capsule of the joint. This is not common; the fact is that the appearances resembling dislocation on the dorsum of the ilium are most frequently caused by changes in the form of the head of the femur and of the acetabulum. The head of the femur may become absorbed to a great extent, and the muscles, by acting on the shaft, may give rise to the appearance of dislocation (plate xiii. fig. 3). Or the acetabulum may suffer to a much greater extent than the head of the bone, which then sinks deeper in, and in this case we often meet with abscesses opening into the anus or vagina. The pus formed in the acetabulum bursts through into the pelvis, making its way through the obturator internus and obturator fascia, and appears by the side of the rectum. In other cases the head of the femur may be locked in the acetabulum from deposit of new bone round the margins of the cavity, and yet the appearances may be those of dislocation. There is no doubt that sometimes dislocation of the head of the femur really does take place, but generally the appearance of dislocation is caused by the head of the femur lying deeply in the acetabulum, or sometimes even in the pelvis, when it has broken through the acetabulum into that cavity, or owing to carious absorption of the head and neck of the femur.

LECTURE XL.

Treatment of Morbus Coxarius, as exemplifying the treatment of Ulceration of Cartilage in general—Question of excision and amputation of different joints—Chronic Rheumatic Arthritis ; its History, Pathology, and Treatment—Hysterical Affections of joints.

In Morbus Coxarius, as in all other joint-diseases, the first and most important part of the local treatment consists in securing perfect rest of the affected joint, and distraction of the diseased articular surfaces. When the hip-joint is affected, these objects must be attained by keeping the patient in the recumbent position, and by fixing the movements of the trunk, and also of the knee and ankle joints. For this purpose we may employ the bracketed splint shown in plate xiii. fig. 4, as it prevents pressure on the affected part and permits the use of local applications ; a still better method, however, is to keep up constant extension by means of the weight and pulley, as described and figured in fractures of the thigh ; at the same time that we control the lateral movements of the limb by means of sand-bags. The rest and extension must be maintained for at least six or seven weeks, perhaps much longer, as eight or nine weeks. If any local irritation exists, it should be soothed by the application of warm or anodyne fomentations ; and by these means, together with those which are necessary for the restoration of the general health, and which consist in the administration of good nourishing diet, codliver oil, and occasionally tonics, such as quinine or chalybeates, we may, in a great many cases, cure the disease in the earlier stage without any further treatment. The great disadvantage of these methods of extension is, that they interfere injuriously with the general health of the patient by preventing him from getting plenty of fresh air, and at least passive exercise. Still, in the earlier stage of the disease, the risk from the patient's being confined to bed is less than that which would arise from using greater freedom. In order to compensate for the wants just indicated, the bedroom must of course be well ventilated, and after about five or six weeks the patient may be taken out into the open air in a carriage, and thus allowed the benefit of passive exercise while the joint is still maintained at rest. In some cases, after five or six weeks, we use a starch bandage from the foot upwards, round the pelvis and hip. This, from its rigidity, prevents to a great extent the movements of the hip ; but in hospital practice the long splint, in a modified form, is more simple. Amongst the poorer classes, the results of treatment are less favourable than those which are obtained amongst the middle and upper classes. A patient cannot

be kept in hospital till the disease is thoroughly cured, for that would require about a year or eighteen months. Besides, the patients are seldom brought to the hospital in the earlier stage of the disease, or indeed before deformity and shortening take place; and when the disease has been allowed to go on so far as this the splint alone is not likely to do much good.

The problem of maintaining extension and consequently distraction of the opposed articular surfaces, and yet allowing the patient to be out of bed, has now, to a certain extent, been solved, by the use of Sayer's or the American Extension Splint. When this apparatus is properly adjusted, extension and counter-extension are kept up, so that after the more acute stage has been successfully treated in bed, the patient can get up and walk without pain, and without the movement affecting the hip-joint. For some time, however, the extension weight should be continued at night, when the apparatus is taken off at bed-time.

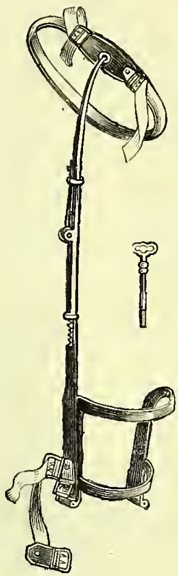


Fig. 30.

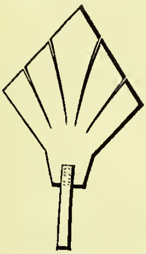


Fig. 31.

Sayer's Hip-joint Splint (fig. 30) consists of two portions, the upper made of corrugated steel, attached by means of a universal joint to a pad of proper size, fitting on the dorsum, below the crest of the ilium, and holding in place a perineal band, adjustable by strong webbing and buckles. The lower portion is simply a ratchet bar sliding within the first; to its inferior extremity are attached two semi-circular bands, embracing the thigh just above the

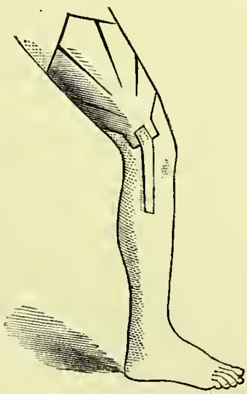


Fig. 32.

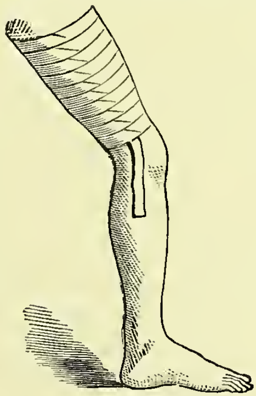


Fig. 33.

knee. Extension is made by working the splint with the key. The bar is easily adjusted to either side of the thigh-piece by means of a screw, so making the splint answer for either limb.

To apply the splint, we require to cut two pieces of strong dimity

adhesive plaster, similar in shape to fig. 31, one large enough to reach from the perineum to within two inches of the condyle of the femur on the inner side of the thigh, the other precisely the same for the outside. We next sew on the narrow end of each—not on the plaster side—a strong piece of webbing, five or six inches long, by one inch broad, and applying them to their proper places, fig. 32, and pressing them with the warm hand to obtain a firm adhesion, we secure them further by a roller bandage, fig. 33.

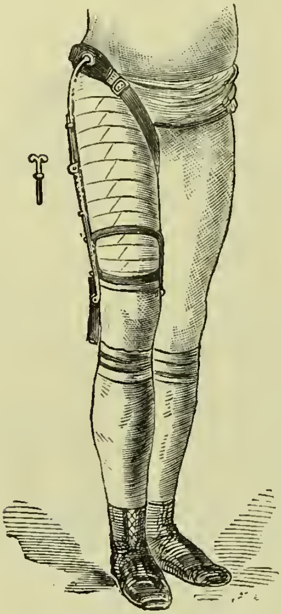


Fig. 34.

The splint is now laid over the thigh, the two pieces of webbing are firmly fastened over the rollers on the ends of the splint to the buckles, and a third one around the back of the thigh. The perineal band is now adjusted, and the instrument extended with the key, just enough to make the patient comfortable, and then locked by pulling the slide down over the spring, fig. 34.

Splints constructed upon the same principle are sometimes employed in cases of knee and ankle-joint disease. In these cases, however, the apparatus is not nearly so effective, and, moreover, it is very cumbrous.

If the pain in the joint should increase, we must have recourse to still more active remedies, such as counter-irritation, and by far the best method of producing this, in connection with deeply-seated diseases of bone, is by the application of the actual cautery. If this be done behind the great trochanter, it will often be the means of arresting the disease even when it has passed beyond the first stage, and when ulceration of the cartilage has begun. If abscesses form, they must be opened; but the patient generally sinks when there is much suppuration, and if he recover, it is only with a greatly deformed limb.

In other joints, before this stage is arrived at, amputation of the limb, or excision of the joint, should be performed; but in the hip it is different. The question in all cases of excision is—Can we remove the whole of the disease? In the shoulder-joint the head of the humerus and the glenoid cavity can be completely removed, so that all the disease can be got rid of, and so also in the elbow and knee joints; but in the hip-joint it is of no use to excise the head of the femur and leave the acetabulum which is also diseased. Then comes the question—Can we excise the acetabulum? In some cases with a gouge we may remove a considerable part of it when diseased; and therefore, in certain cases of morbus coxarius, I can see no harm in cutting down upon the joint, removing the head of the femur, and then, if necessary, scooping out part of the acetabulum. I have done so in many cases with advantage, leaving a tolerably useful limb. But before attempting to excise the joint, we should first try a careful and prolonged treatment, as before

described. Some surgeons advocate amputation at the hip in cases of morbus coxarius, but I do not think it is to be advised, although some successful cases are recorded by Mr. Holmes, and I have recently performed this operation with success. It is perhaps even less warrantable, except under special circumstances, than excision of the head of the bone.

In the shoulder-joint the operation of excision should be performed early, because then the muscles are little altered, and the whole of the diseased textures can be readily removed. Here it is principally the head of the humerus that is affected, and not so much the glenoid cavity. In fact, I have never had to remove the whole of the glenoid cavity for the disease, but only parts of it. A very useful limb is left after excision of the shoulder-joint.

In the elbow-joint there can be no doubt as to the propriety of early interference, because we thus save the patient's strength and obtain a more useful limb than would result from anchylosis; this applies also to the shoulder-joint. In the wrist the joint should also be excised early, and a very useful hand will generally be left.

In the knee-joint the question arises, whether an anchylosed knee after long treatment is better than a knee after excision of the joint. If the diseased action be pretty extensive over the surface of the joint, and if there be great local pain and irritation from that source, and the ends of the bones evidently much affected, then, if the patient's health has not suffered very much, and if the constitution be not very irritable, excision of the joint is the proper treatment. In other cases, where there is much suppuration round the joint, and where there is gelatinous degeneration present, excision of the joint is not so suitable. I think that those cases where the diseased action in the knee is well marked and limited to the bone, without much suppuration, and where the general health has not suffered much, are better suited for excision than those cases in which there is an unhealthy condition of the synovial membrane. The most successful cases I have had have been in young females under thirty, where the general health has not been much affected, and where the local disease was very great. In male patients again, the results have not been so successful, though why it is so is not very clear. It is not every case of diseased knee-joint that is suited for excision; but in properly chosen cases, the operation is likely to be successful. Were it done in all cases in which amputation used to be performed, we would find that the statistics of excision would be much less favourable than those of amputation. When we contrast the amputations performed for disease of the knee-joint with excisions for the same disease, we find, as a general rule, that the former are much more successful—the deaths from amputations being 1 in 7, those after excision 1 in 3 or 4.

Excision of the knee-joint is an admirable operation in many cases, but if we wish to preserve its character we must be very careful to ascertain the cases best suited for its performance.

In disease of the ankle-joint excision is not often required, for even after suppuration and great disorganisation of textures has occurred, we often find that by persistent constitutional treatment, and with perfect

rest, a cure will be accomplished by anchylosis. In the wrist-joint, in a great many cases, especially in adults, amputation of the forearm is to be preferred to excision of the joint. But if we see the patient early in a case of acute ulceration of cartilage, excision should be performed, for though it be a far more difficult and tedious operation, it leaves a very useful hand. When the parts are much disorganised, amputation must be performed. In two cases of gelatinous degeneration, for which I performed the operation of excision at an early period, though both did well for some time, yet they afterwards required amputation. The state of the constitution attendant on gelatinous degeneration is not so favourable as that met with in other joint-diseases for operations requiring a long period of convalescence.

In all cases of diseased joints, when the patient is very much exhausted, when hectic fever has come on, and when all means have been tried to save the limb, then amputation must be performed, and it is well not to let the patient's health sink too far before operating. In the knee the disease should not be allowed to go on till abscesses have formed all round it, as the operation will be much less likely to prove successful then than if done before, and the risk of pyæmia will be much greater. If we require to amputate where chronic abscesses are present, they should not be opened till the operation is performed, and then they should be freely opened, and painted afterwards with the tincture of iodine. If they are opened beforehand, irritative fever is often the result, and will, of course, tell very much against the operation afterwards.

There is a disease of the hip resembling morbus coxarius in some of its characters, and which has been sometimes confounded with it, but which seldom arises until the patient is considerably above forty years of age, while morbus coxarius generally occurs in childhood.

The disease I refer to is Chronic Rheumatic Arthritis of the hip-joint. This has been described under a variety of names. If the patient has been seen early, and the fibrous and synovial structures chiefly examined, the disease is named after some change in them. If the osseous textures are examined, it receives its name from changes in them. It has been termed " interstitial absorption of the neck of the femur," because the neck of that bone becomes so shortened as almost to lie below the level of the trochanter (fig. 36). And it has been called " porcelaneous disease," on account of the peculiar alterations which take place in the texture of the bone. The cancellated portion seems to be first opened out and then to become dense again, so that there are large foramina left on the surface. Then, wherever the cartilage has been absorbed, the articular surface of the bone is noticed to be covered with a sort of china-like deposit of a glistening smooth appearance and great hardness. This causes the movements between the opposite surfaces to take place with a peculiar creaking noise. From its appearance and qualities it has been called the porcelaneous deposit, hence the disease has been termed " porcelaneous disease " of the joint.

These terms express only parts of one diseased action: the alterations described do take place; but they are changes going on from one structure to another, and we require to look at all the textures in study-

ing the disease. We find that both the acetabulum and the head of the femur became altered in form (fig. 35); the cotyloid ligament running round the margin of the cavity is filled with earthy deposit, so as to become almost ossified. The bone itself is denser, and the cartilage is absorbed, its place being taken up by fibrous texture, throughout which we see the porcelaneous deposit appearing. Projecting from the synovial

Fig. 35.

Fig. 36.

membrane are a variety of small fimbriated structures which pass into the openings of the cavities, or enlarged Haversian apertures seen in the bone. These fimbriæ are highly vascular. Every texture in the joint is affected, the fibrous being perhaps that first affected. The disease is a rheumatic one, and comes on very slowly in after-life, and in patients whose general health is otherwise good, and who have usually much muscular power.

The history of the disease is somewhat as follows :—Towards night the patient feels great pain of a rheumatic character about the hip and the knee joints. The pain ceases in the daytime, and recurs at night. The patient probably takes medicines, which give relief for a time, but some exposure to damp or cold brings with it a return of the symptoms. After a time he begins to experience a sense of lameness; he cannot walk erect as formerly, nor bear any weight on the limb, and there is some swelling and deformity beginning to present itself, together with a corresponding degree of stiffness, so that the patient cannot flex the joint, and cannot go up and down stairs as formerly (fig. 37). This arises from the progressing changes which are taking place in the joint and in the fibrous textures surrounding the acetabulum. The limb becomes much

Fig. 35. Head of femur and acetabulum much altered by chronic change; causing shortening of the limb, and stiffness of the joint.

Fig. 36. Femur bisected; head atrophied and altered; neck gone; the result of interstitial absorption. Shortening and lameness inevitably great.

altered, the foot and knee are everted, and the limb shortened (figs. 38 and 39). The appearance presented is very like what occurs in fracture of the neck of the femur, for which accident it may be mistaken; although in this disease the symptoms result from alterations in the head of the femur. It is well to keep this in mind, for it may happen that a patient suffering from this form of disease in its early stage falls or receives a blow upon the hip or trochanter, and under such circumstances interstitial absorption of the neck and head of the femur is likely to proceed rapidly, and unless the surgeon guards himself by forewarning the patient and his friends he may be afterwards blamed for having overlooked a fracture of the neck of the femur.

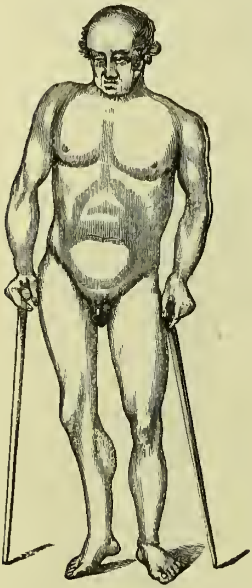


Fig. 37.

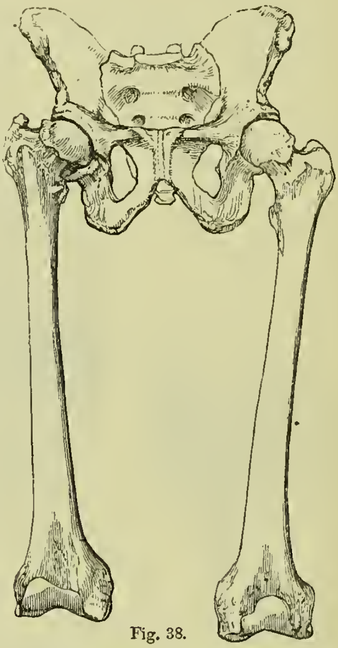


Fig. 38.

There is good reason to suppose that not a few of the museum specimens of osseous union of intra-capsular fracture of the neck of the femur are the results of interstitial absorption after a blow or fall.

In chronic rheumatic arthritis the general health of the patient is seldom or never affected. There is atrophy of the hip to a certain extent, but not nearly so much as in morbus coxarius. The alteration which takes place is, in fact, not so much due to atrophy as to an altered line of the muscular fibre, which gives rise to an appearance of it. Instead of the limb being wasted below, as in morbus coxarius, we find that the calf of the leg is preternaturally developed.

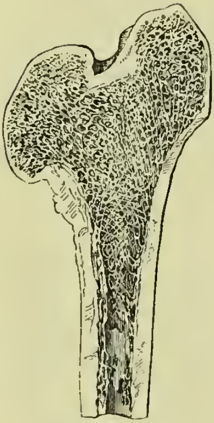


Fig. 39.

Treatment of chronic rheumatic arthritis.—In the earlier stages, depletion by cupping, keeping the patient quiet, and the use of colchicum, will do a great deal to prevent the disease from going further. If,

Fig. 37. Chronic rheumatic arthritis.
Fig. 38. Comparative view of this cause of shortening of the hip.
Fig. 39. The same isolated, and bisected.

however, it still goes on, the actual cautery and the long-continued use of the iodide of potassium are the best methods of preventing the structural changes from taking place; but as the pain only comes now and then, the patient is seldom treated persistently. In fact patients rarely apply for aid until the disease has made considerable progress, or when suffering an acute exacerbation of symptoms, and generally leave off remedial measures whenever pain is relieved.

The disease is met with in persons of rheumatic habit. The diseased action is therefore not to be classed with morbus coxarius; it is simply a rheumatic affection requiring persistent treatment. In many of these cases the use of the warm douche and salt-water bathing is beneficial—warm bathing being generally the best. Preparations of sulphur may also be given with advantage, but the iodide of potassium is a much more efficient remedy than any of the more popular ones. The disease attacks the knee, elbow, and shoulder-joints, as well as the hip. It is pretty frequent in the shoulder, and sometimes leads there to most serious consequences.

A very acute form of disease of the hip, attended with local and general symptoms not unlike those of acute ostitis, is occasionally met with. It seems to be dependent upon acute inflammation of the bone and periosteum. In most cases which have come under my notice the pelvic bones seem to have been affected in the first instance, leading to ulceration of the cartilage of the acetabulum, and thus producing acute disease of the hip-joint. The amount of irritative fever attendant on it is very considerable, and is often of the typhoid type, as in acute necrosis.

It may arise in scrofulous and rheumatic patients, from exposure to either cold or damp, and I have seen it follow upon uterine irritation, either from operation on, or exploration of that organ. From the acuteness and urgency of the symptoms these cases are attended with great anxiety.

The general treatment, although more active, must be conducted on the same principles as guide us in the treatment of acute ostitis and morbus coxarius. The peculiar typhoid state requires attention, and the use of chlorate of potash and iron is generally indicated.

Attention was first directed to Hysterical Affections of Joints by Sir Benjamin Brodie, who stated that they were a frequent source of wrong diagnosis, and in that way often led to very serious results. The joints most commonly affected with it are the hip and knee. The symptoms simulate those of almost all articular diseases. It generally occurs in females, or in males who are otherwise in weak health. The symptoms are the same as those of disease of a joint—generally exaggerated; the pain is extreme, there is sleeplessness at night, and jerkings of the limb, the patient is unable to bear any pressure on or movement of the limb, but there is no apparent swelling. It is sometimes very difficult to arrive at a correct diagnosis, especially if, as often happens, remedies, such as fomentations and blisters, have been applied previously to relieve pain, and have caused a certain amount of swelling and stiffness in the joint. The patient has a quick pulse, an irritable tongue, and often an anæmic appearance. She complains of

excessive pain, which increases at night. On making an examination we cannot feel much swelling in the joint, though we may find a slight degree of effusion into it.

From the similarity of the symptoms to those of joint-disease the diagnosis is very difficult, and operations have sometimes been performed for what is really a neuralgic affection, under the belief that the joint was diseased. We may, however, find both hysterical affection and the incipient joint-disease existing at the same time. A good test to find out whether joint-disease is really present, is, when talking to the patient, to press heavily upon the joint, and not touch it lightly. If the patient complains, and writhes as in agony, when we merely press lightly on the surface, we may suspect, the hysterical character of the disease. If the joint be not affected, the patient will complain of no pain, while, if there be any articular disease, the pain will be great on pressure. We should then examine the patient when she is off her guard, and also when under chloroform, when if there be no structural disease the free smooth movements of the joint will satisfy us as to the real nature of the case. Much care and experience are required in diagnosing such cases. We should never be in too great a hurry to operate when there is any doubt as to the real nature of the disease.

As regards the treatment of hysterical disease of joints, the warm or cold douche is very beneficial; and, internally, chalybeate tonics are the best medicines.

LECTURE XLI.

Various forms of Bursæ—Acute and Chronic Bursitis and its treatment—Special organic alterations in Bursæ and the treatment adopted to these—Solidification of Patellar Bursæ, and operations for their removal—Thecal Bursitis, acute and chronic—Bursal swelling at wrist containing loose bodies—Special treatment.

Nearly akin to diseases of the joints proper are those affections in which the *bursæ mucosæ* are involved. We shall, therefore, consider the diseases of bursæ before entering on the subject of fractures and dislocations.

Bursæ are met with in various parts of the body. They are sometimes placed deeply, in situations where muscles or tendons glide over each other or over the osseous structures underneath, and sometimes subcutaneously, where they are interposed between the skin and prominences of bone. The texture in the interior of the bursa is like that of the synovial structure; it is perfectly smooth, and secretes a small quantity of fluid. Normally, the bursa is composed of a very delicate texture, and around it, and forming its covering or capsule, is fibrous tissue. If we take the bursa met with over the patella as an example, we find the sac to be pretty regular in form, with a thin fibrous texture forming its outer covering, and lined by a fine, smooth, synovial structure which secretes a fluid like synovia, but somewhat more limpid. The object of the bursa is to allow of free movement between the surface of the patella and the textures which pass in front of it, and also between the tendon and the skin. In other cases a bursa lies between strong muscular fibres or the aponeurotic texture lining muscles, or over the tuberosities of bones near articulations, such as the great trochanter of the femur. Thecal bursæ are also met with, arranged along the sheaths of tendons in an elongated form, as at the wrist-joint, where they extend for a considerable distance along the flexor tendons, and so allow of very free movement. The uses of bursæ are so obvious that we need hardly allude to them. We often find bursæ being formed adventitiously where more than usual pressure or movement takes place, as in talipes varus or club-foot, where bursæ form, sometimes of a large size, so as to obviate the effects of constant friction, and the weight of the body, on a part of the foot not intended to bear pressure. Ganglion is the name given to an adventitious bursa arising under such circumstances. Ganglia are most frequently met with amongst the extensor tendons on the posterior aspect of the wrist, and result from continuous use of the fingers, as in playing the piano, drawing, and knitting. The distended thecal bursæ, situated amongst

the common flexor tendons in front of the wrist, do not belong to this class. They arise from an affection of the proper sheath of the tendons. (plate xiii. fig. 7).

Bursæ, like other textures, are liable to inflammation, which may be either acute or chronic—generally chronic, although in the more exposed bursæ, such as that over the patella, often of the acute form.

In acute Bursitis the symptoms are as follow:—The position of the bursa becomes marked by a tense rounded swelling which suddenly arises. This is accompanied by pain, redness on the surface, and much stiffness of the joint. The swelling conveys to the touch a feeling of distinct fluctuation, and the patient begins to suffer from symptomatic fever. There is increased secretion of fluid, causing increase in the size of the swelling; the fluid becomes vitiated in character, and very soon has a tendency to become purulent. At first there can be no difficulty in the diagnosis of the disease, but, as it progresses, the decided diagnostic symptoms become less noticeable, and very speedily —often in less than a couple of days—the whole limb swells from the inflammation. The vessels relieve themselves into the cellular tissue, giving rise to acute œdema of the surrounding textures, with erythematous inflammation spreading from the site of the bursa; and the case might now be mistaken for erysipelas of the thigh or leg. There may also be a difficulty in distinguishing it from disease of the knee-joint, as the swelling is not defined, but the fluid is superficial to the patella or ligamentum patellæ, and does not therefore correspond to the fluid within the synovial sac. In the patellar bursa, however, the symptoms of acute bursitis are perhaps more marked than in any other.

The *Treatment* is very simple. Absolute rest, with the limb in a straight position, is essential, as in all affections of joints. Leeches and warm fomentations should be applied over the inflamed bursa. These remedies, if employed early, will very often arrest the inflammatory action, and cause the disease to terminate by resolution. If the diseased condition should continue, we must take measures to obviate the effusion into the surrounding tissues, and localise the inflammation as much as possible. When the symptoms have become more marked, the patient may have a rigor, which affords an indication that suppuration has begun. The fluid is still confined within and distends the sac; the sooner, therefore, the bursa is opened the better. There is a difficulty, of course, as to the absolute diagnostic symptom of matter being present in the sac, in consequence of fluctuation being present from the very first; but when the symptoms increase in intensity, and rigors come on, the bursa should be opened, for even if pus has not fairly formed, we generally find that a large quantity of vitiated bursal fluid is got rid of, and the disease is cut short more easily. Hence we ought never to hesitate, in cases of acute bursitis over the patella, or wherever the bursa is superficial, to treat it in this way. When the bursa is deeply seated we require to act with more caution, for we may have to deal with inflammation of the joint as well as with acute bursitis, and the swelling may be caused by disease of the joint, or by the formation of abscesses within it, and so the diagnosis becomes more difficult. But in all cases the presence of acute pain, tension, and suppuration,

indicate that we should make a free incision, and let out the matter. In cases of acute bursitis over the patella, we sometimes meet with abscess stretching up the thigh and down the leg. This must be treated as diffuse suppuration arising from any other cause would be—namely, by being early and freely opened. When opening a suppurating bursa, it is sometimes as well to make a lateral incision, besides a free central one, and introduce a piece of drainage tubing, so as to let the matter drain off more readily. The after-treatment is conducted in the same way as that of an ordinary abscess, by either poulticing or water-dressing, as occasion may require.

Chronic Bursitis arises in general from continued pressure on, or movements of the part. The so-called "housemaid's knee" (plate xiii. fig. 8), is an example of it, and arises from kneeling constantly. In chronic bursitis, the pain is not so great as in the acute form. There is stiffness in movement, and a gradually increasing swelling, which at last becomes very prominent, and prevents the patient from going about. The *Treatment* of chronic bursitis will depend very much on the condition of the bursa. If the disease be seen in the early stage, before much change has taken place, and when as yet there is only thickening of the external fibrous capsule, and a larger amount of fluid than usual has been secreted from its smooth internal surface, then the ordinary plan of treatment will suffice. This consists in keeping the limb at rest, and applying a blister, so as to excite action and cause absorption. These results are further favoured by painting over the surface with iodine, and bandaging. In a very large number of cases we will succeed in curing the disease by such means, more particularly if they are followed up on the part of the patient by avoiding pressure and any other of the originating causes.

In other cases, however, we find that whilst the swelling is not very large, and can be got rid of at the time, yet it returns very rapidly so soon as the patient goes about again, and subsides when he remains at rest. These phenomena give indications of conditions very different from those above described. They tell of more extensive organic changes. The interior lining membrane undergoes alteration in structure. It becomes fimbriated, and projecting across it at intervals are to be found fibrous bands. Not unfrequently it contains a quantity of loose movable bodies of different sizes. Thus we find that not only is the natural surface in a state of inflammation, but there is really an altered structure, and therefore the ordinary plan of treatment will not effect a permanent cure. Rest, of course, is essential. An incision should be made into the tumour, the fluid evacuated, and all the loose movable bodies removed. The surface of the sac should then be painted over with strong tincture of iodine. When the tumour is smaller in size, and its contents completely fluid—that is, when no foreign bodies can be felt in it—we may treat it as already indicated, or we may use the trocar and canula, as in hydrocele, to draw off all the fluid, and then inject the iodine. There is not the same danger in injecting iodine into a bursa as into a joint. When the bursa is not very large the best plan is, I think, to make a free longitudinal incision, and then paint the interior of the sac with iodine, and afterwards bandage the

limb from the foot upwards. If the tumour be large, and no foreign bodies can be felt in it, the treatment by the trocar and canula will answer better.

The disease may go on to other changes. The fibrous texture often becomes enormously thickened, and the capacity of the cavity diminished. The external texture becomes dense, and fibrous bands project across the interior (plate xiii. figs. 9 and 10). This thickening process goes on till the tumour becomes almost or altogether solid. It then contracts slightly in bulk. Under these circumstances, the simplest plan of treatment is excision of the solid mass. An incision should be made longitudinally over the tumour, and then the solidified bursæ, together with any adherent skin, should be dissected out. There is no risk incurred in the operation. If we are afraid of injuring the patella or the capsule of the joint, we can leave a thin portion of the fibrous texture behind. There is no chance of a return of the tumour, as there would be if it were malignant. Excision is the only method of treatment applicable to these growths when they become solid or nearly so. Injecting iodine would do little good; it might obliterate the cavity, but would leave the solid part unaffected.

The tumour, instead of becoming entirely solid, may ulcerate and present a large fungating mass on the surface, which looks like a malignant growth, but is really simple. In one case lately under my care the bursa over the patella was filled with a bloody grumous fluid like that of hæmatocele. This is called hæmatocele of the patellar bursa, but it is a very rare form of disease.

The bursitis of thecal bursæ is subacute or chronic in form. It occurs often after exposure to cold or wet. It is generally met with in the tendons of the peronei and tibialis posticus, and other tendons about the ankle. There is pain in the tendons, and also a peculiar creaking noise when they are moved. This is partly due to a subacute form of rheumatic affection of the fibrous texture of the sheath, with effusion between it and the tendon. The creaking sensation is owing to friction between the surfaces roughened by exudation, and it is sometimes so marked as to be mistaken for the crepitus of fracture.

At the wrist-joint, after frequent attacks of this diseased condition, we have the thecal bursa investing the flexor tendons becoming affected. The effusion begins to assume a chronic form, and is more or less constantly present, interfering with the movements of flexion and extension. There is a distinct swelling in the central part of the forearm near the wrist, which seems to stop suddenly where the flexor muscles terminate in their tendons. In the palm of the hand there is also a fulness, though less noticeable. This is due to the thick palmar fascia not allowing the projection of the fluid so much as the thinner fascia in the forearm does. On pressing the swelling in the forearm the palmar fulness increases, whilst the indentation at the wrist becomes more marked. The indentation at the wrist is caused by the strong annular ligament forming a constriction there (plate xiii. fig. 6).

In thecal bursitis the ordinary plans of treatment may be had recourse to, and will generally cure the disease if applied in the early stages. After a time there is always more or less swelling, which

returns whenever the hand is moved. This is generally due to a number of disc-like bodies and loose fibro-cartilages which form in the thecal bursa. The deobstruent remedies, which are useful in the other forms of bursitis, are of no use here. By using them we may get rid of the fluid, but not of the solid bodies. There is, therefore, only one efficacious plan of treatment—namely, to make an opening into the swelling and remove the loose bodies. In performing the operation an incision is first made through the central line of the swelling above the wrist, and the upper cavity completely emptied. The finger or a director is then passed down in front of the tendons till the annular ligament is felt. Under this we glide a probe-pointed bistoury, and divide the constriction subcutaneously without injuring the skin of the palm. The contents of the palmar portion of the sac can then be easily pressed out through the upper opening. The surface is then lightly painted over with iodine, which prevents too much suppuration from taking place, and also greatly facilitates the cure. Subsequently warm-water dressings are applied, and the hand and wrist bandaged. The patient must be made to move his fingers slightly, so as to prevent adhesions from taking place between the tendons and their sheaths. In this way the disease is completely got rid of; but such treatment is only to be adopted when the case has resisted the other methods before spoken of.

The ganglia or adventitious bursæ vary in size and in consistency (plate xiii. fig. 7). If they are very small they often disappear without any treatment. Formerly blisters and other remedies were applied. If these failed, the patient was made to clench his fingers, and the surgeon tried to burst the ganglion by a hard blow, but this very often failed to effect a cure. Rupture took place only at the weakest point of the bursa, allowing the effusion to escape, but the wound in the cyst healed and fresh effusion was formed. The plan I have found most effectual is to pass a small tenotomy-knife or a large cataract needle obliquely through the skin till the bursal swelling is entered. The point of the instrument is then moved about so as to tear up the wall of the cyst or sac of the bursa in all directions, and so cause sufficient inflammation to produce adhesion, and prevent re-accumulation of effusion. Slight pressure is then to be applied on the part by means of a firm compress and bandage, and the hand kept quiet for some time.

LECTURE XLII.

Injuries of Bones and Joints—Definitions of the terms Fracture, Dislocation, Diastasis—Diagnostics of Fracture and Dislocation in general—Classification of Fractures—Simple Fracture—Reduction and Coaptation—Transverse and oblique Fractures—Various causes of Displacement—Retentive Apparatus—Constitutional Treatment—Period at which a Fracture is consolidated—Process of Union.

Having discussed the diseases of bones and joints, I now proceed to the consideration of the injuries to which they are liable. In treating of fractures and dislocations, whether generally or specially, I make it a rule to treat of them together instead of separately. This at first sight might seem to imply a want of arrangement, but in reality it is the best method, as it enables the teacher to bring more fully before the student the points of similarity and dissimilarity between fractures and dislocations, and by force of contrast to impress them with the importance of the conditions of greatest value in reference to diagnosis and treatment.

A fracture may be defined as a solution of continuity in any bone; a dislocation is an obnormal separation of the articular surfaces of two bones from each other; diastasis is a term used to denote a solution of continuity between the epiphysis and shaft or body of a bone, an accident which occurs in young persons (fig. 40). In all these conditions there is of course a displacement, but the term dislocation is in surgery restricted to the displacement of the articular end of a bone from its corresponding cavity or surface.

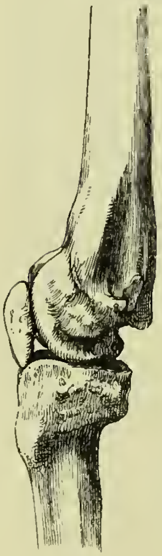


Fig. 40.

There are certain general symptoms present in all fractures. First, distortion and shortening of the limb, with some swelling and pain; unnatural mobility at the site of the fracture when the surgeon moves the limb; also crepitus, or a peculiar crackling sensation, caused by the opposed surfaces of the broken bone grating upon each other, and this is considered as the peculiar diagnostic symptom of fracture. We cannot, however, always trust to this symptom, as in diastasis in the young, when the bones are not quite ossified, little or no crepitus will be heard or felt.

The symptoms of dislocation or luxation, as compared with those of fracture, are distortion, as in fracture, owing to displacement of the limb, swelling and pain, the

Fig. 40. Diastasis of Femur in a young person—Reunited.

FRACTURES

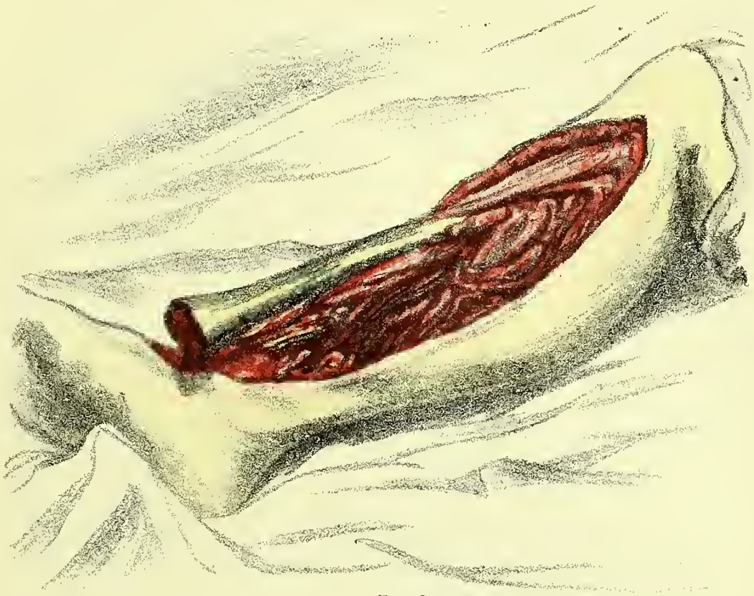


Fig. 1

Fig. 2

Waterston & Son Edin. Lith.

latter being increased on attempting motion. The altered form of the part is caused by the absence of the articular end of the bone from its normal position, and its projection in some abnormal direction. The deformity caused by this is generally greater than in fracture, owing to the larger size of the articular extremities of bones as compared with their shafts. These general symptoms of fracture and dislocation are somewhat in common: distortion, pain, swelling, and deformity, caused by displacement—the character of the deformity being slightly different in the two cases. The absolute diagnostics between luxation and fracture are absence of crepitus, immobility of the dislocated limb, whether motion be attempted by the patient or surgeon. Thus in the shoulder-joint the arm cannot be moved from the position in which it is fixed, and this immobility used to be stated as the absolute diagnostic between dislocation and fracture. This is not true however in every sense, for in certain dislocations there is sometimes abnormal mobility, though not the normal movement of the joint. In these dislocations the parts can be moved in directions where movement could not have been exercised before; thus, at the elbow, when the joint is dislocated, free lateral movements can be made, which could not have been effected in the normal state of the parts; but the natural movements of flexion and extension cannot be performed. Still this is no objection to the term immobility being used, for it is used with regard to the natural movement of the joint. In dislocation there may be either lengthening or shortening of the limb, while in fracture, with one or two exceptions, there is always shortening. Such exceptions are certain fractures of the pelvis, and fracture of the trochanter major, where, from the muscles which support the limb losing their attachments, the limb is apparently lengthened or droops, but in almost all other fractures shortening of the limb occurs.

In regard to the diagnostic symptom of crepitus there are certain conditions to be borne in mind. If the ends of the fractured bone override each other, there will be no crepitus. In fractures of the neck of the femur there is often no crepitus, when the parts are widely separate, and it is only by bringing the ends of the bone into contact that we can elicit it; again, in certain cases of impacted fracture this symptom may also be absent. In dislocation of the humerus it is not uncommon to feel a slight crepitus on moving the limb, owing to the osseous attachments of muscles being partially torn off by the force causing the dislocation, but, as a rule, there is no distinct crepitus in dislocation. Such are the general appearances of, and differences between, fractures and dislocations.

Fractures are classified into—

Simple, where the bone is merely broken across transversely or obliquely at one point.

Comminuted, where the bone is broken into fragments.

Compound, where there is a wound caused either by the bone bursting through the soft parts and appearing externally, or caused by the force which produced the fracture wounding the soft parts down to the broken bone. It is, in fact, a wound of the soft parts communicating with the fractured

point. The mere existence of a wound in the immediate neighbourhood of a fracture does not necessarily constitute a compound fracture, unless the wound communicates more or less directly with the point fractured.

Compound comminuted, where there is a wound communicating with the fractured bone, the bone itself being shattered into fragments.

In simple and in comminuted fractures there is no solution in the continuity of the integument, and no external wound. In the compound and in compound comminuted fractures there is an external wound communicating directly with the fractured bone.

Fig. 41.

Incomplete, or *Greenstick* Fracture, as it is termed, almost invariably occurs in the young, before the bone is thoroughly ossified. In such cases the bone yields, and bends, and breaks partially on the convexity, as represented in the accompanying figure. This form of fracture is most frequently met with in the bones of the arm, forearm, and clavicle.

In SIMPLE FRACTURES, as a rule, the injury is caused by the lowest degree of violence; if the fracture be caused by indirect violence, as by jumping or falling, the injury is at its minimum. Here there is pain and distortion, with a certain amount of swelling if the limb be not speedily adjusted, and crepitus on moving the broken ends of the bone.

The reduction of a fracture consists in making extension and counter-extension on the lower and upper parts of the bone, if the ends of the bone are over-lapping, until the broken ends of the bone come into contact. Coaptation is the exact fitting of the broken surfaces to each other. When this is effected, the fragments must be kept in position by means of retentive apparatus. In applying this, we must fix the neighbouring articulations as well as the broken ends of the bone, so that no movement can be made which would affect the fractured point. The mechanical retentive apparatus is generally very simple, consisting usually of a wooden or pasteboard splint on either side of the limb, passing from the joint immediately above the fracture to that immediately below it, and retained by slip-knots or a bandage, so as to fix the limb completely. In other cases a pad in certain places is necessary, to prevent the bone being drawn in towards the trunk. In treating a fracture, whether by retentive apparatus, such as splints or bandages, or by extension, by weight and pulley, and attention to the position of the limb, it is most important always to keep in mind what are the displacing causes of the fracture; what are the conditions, whether muscular or otherwise, which led to the displacement originally, which tend to displace the bone after it has been set, and which therefore require to be obviated. Without attending to these points we can never treat a fracture on proper principles.

Fig. 41. Greenstick fracture of the femur.

If a fracture be transverse there is very little displacement and no difficulty in keeping the fragments in position. In oblique fracture, the greater the obliquity of the fracture the greater is the difficulty of treating it. There is a constant tendency for the broken surfaces of the bone to glide upon one another, so that extension and counter-extension are necessary to keep them in accurate contact. Oblique fractures always give trouble to the surgeon, and require great care and attention in treating them. To keep up a certain amount of extension and prevent lateral movement are the general indications of treatment. For this purpose in fractures of the lower extremity the weight and pulley method will be found most useful.

The displacing causes vary of course in different cases. In each fracture there are certain particular displacing causes; but there are some which are common to them all, such as the muscular displacing causes, the weight of parts which have lost their support, the force causing the injury, the direction of that force, and the direction of the obliquity of the surfaces of the bone. In fracture of the surgical neck of the humerus, for example, the upper end of the shaft of the bone is drawn in towards the chest (plate xvi. figs. 5 and 6). This is caused by the action of the pectoralis major, the latissimus dorsi, and teres major, the deltoid still further helping to produce this effect. These muscles also draw the lower fragment upwards as well as inwards. The head of the bone is scarcely at all displaced, for the subscapularis counteracts the effect of the supra- and infra-spinatus and teres minor. This is an example of muscular displacing causes. In this case no splint is required; a pad is placed in the axilla, so as to throw out the upper end of the lower portion of the humerus, and the elbow is supported so as to keep the parts in position, the upper arm being at the same time bandaged to the side; and this is all the retentive apparatus required for the treatment of this particular fracture.

In fracture of the clavicle at its middle, we have an example of muscular combined with other displacing causes. The outer end of the sternal portion of the bone projects upwards, and is called the "riding" end of the bone, while the acromial end is depressed and the arm falls down. The principal displacing cause here is not muscular, it is simply the weight of the arm and scapula, unsupported by the clavicle, dragging down the acromial end of that bone. At the same time, however, the shoulders are narrowed from side to side, and the elbow tilted outwards, and this is caused by the action of certain muscles; the pectoralis minor, acting on the coracoid process, and also the pectoralis major, draw in the scapula and shoulder whilst the subclavius, attached to the lower surface of the outer portion of the clavicle, tends to draw it downwards below the inner end of the bone. The displacement of the sternal portion of the clavicle is sometimes attributed to active muscular causes, the outer head of the sterno-mastoid dragging it upwards, and so causing it to project. But this is not the case, because, opposing the sterno-mastoid, and more than counterbalancing its action, are the clavicular fibres of the pectoralis major, which tend to draw the bone in the opposite direction. The sternal portion of the bone is really in its normal position, the outer fragment only being displaced.

As a general rule, the fractured bone is more or less influenced by the muscles attached to different parts of it; and in the femur, for example, if it be fractured at one point the ends of the bone are forced in one direction by the action of certain muscles attached to it, whilst in other fractures, very close to the same part, the ends of the bone are displaced in different directions from the action of other muscles. In fracture of the neck of the femur the foot has a tendency to fall outwards; this is not owing merely to active muscular causes, but also to the normal condition, for when a person is lying down the limb falls to the outside naturally; and in cases of fracture, when the continuity of the bone is broken, the same tendency exists, though somewhat increased by certain muscular causes.

In some fractures, as that of the patella, all that need be done is to keep the limb extended on an inclined plane, and so obviate the displacing causes, and to apply a bandage or plasters with Malgaigne's hooks, so as to keep the fragments as close together as possible. In other cases of fracture the double-inclined plane may be necessary, but this will be more fully treated of under special fractures.

The treatment of incomplete or "greenstick" fracture is obvious, viz. to bend the distorted bone and mould it into its proper form. This is sometimes not easily accomplished, and if it cannot be made straight by pressure then force should be used to convert it into complete fracture and then to treat it as such.

In the general treatment of fracture the retentive apparatus should be so applied that we can examine the parts from time to time, without displacing the splints or moving the limb. For this purpose the splints are generally put on with a sheet or slip-knots, for if we use the continuous roller we must undo the whole apparatus whenever we want to examine the limb.

At first the patient should be put on low diet, and opiates and febrifuge remedies administered to allay any pain or fever; but we should take care not to disturb him much by giving purgatives. We should keep the bowels open by diet rather than by medicine, for any undue moving of the patient is always injurious. After a time we should give better diet than usual; in some cases stimulants are necessary.

Many surgeons adopt the plan of putting up fractures in starch or plaster-of-Paris at first, but I have great objections to this, for when it is used we cannot examine the limb readily when we want to do so. Besides, when we set the limb, and put a starched bandage on it, it fits very well at the time, but as the swelling diminishes the bandage becomes loose, and we cannot tell what is going on beneath. The starch bandage looks very pretty, but when it is taken down we find that the fracture is by no means so well set as if the more simple apparatus had been employed.

A fracture generally unites in from five to six weeks. The consolidation of the bone is then pretty perfect, though the deep-seated part of the fracture is never completely consolidated till about seven weeks after the injury. Up to that time the union of the deeper part of the bone is not complete; it is still soft, and would yield readily if any

weight or pressure were put on the limb. There is most danger of this yielding in fractures of the lower extremity, and hence starch bandage or other retentive apparatus should be applied after the removal of the splints. In fracture of the femur I never remove the long splint in less than seven weeks, nor allow the patient to use the limb for some time after. I have seen cases in which gradual yielding of the bone took place, and deformity occurred, from bearing weight on the limb, and this especially occurs in the young, where the bones as well as the uniting medium are still soft. In the forearm we often remove the splints at the end of three or four weeks, so as to prevent any stiffness in the articulations in the neighbourhood. We require to allow a certain amount of passive movement to prevent thickening, or adhesions of the tendons to their sheaths, but the patient must still be careful not to use the limb freely; only gradual passive movement of the hand and wrist should be allowed. We are obliged to choose between two evils, and therefore choose the less.

On examining a fracture after eight or ten days, we may find it apparently solid, but about fourteen days after the injury we find it less so. The cause of this is that the swelling of the surrounding parts has by this time disappeared. In almost all cases we find consolidation commencing about the end of the third week, the plastic lymph which has been thrown out becoming ossified.

The Process of Union in Fracture has been long a subject of discussion. The old Arabian physicians wrote of the ossifying juices poured out from the broken bone—the *callus;* and surgeons long exercised themselves how to restrain within due bounds the exuberant supply by bandaging, friction, and even by scraping, as recommended by Abulcasis. Speaking of the ideas regarding the exudation of new material for repair of fracture in his day, Mr. John Bell says that many certainly regarded it as "something poured out like lead from a plumber's ladle"; and really if we look to some expressions used, and views held, in our own highly scientific age, I hope I will not be considered uncharitable if I cannot help thinking some such views still exist. What, for example, about that beautiful provision of Nature, *provisional callus,* figured and described in not a few modern works? Does it exist as a necessary part of union if the broken bone be properly adjusted and carefully retained in position? Is it true that the fibrine of the blood, extravasated from the vessels of the broken bone and the torn tissues, is valuable as a concrete, which is to become organised and ossified, and make the broken part, to use a common expression, stronger than before? I would not venture utterly to deny the correctness of such views and such beautiful provisions of Nature; but this I know, that I have had a few opportunities of examining very recently united fractures in persons who died suddenly from other causes, and in such cases I have never seen any trace of the changes described. A little thickening and vascularity of the periosteum, a narrow line of new ossified material, barely perceptible between the broken surfaces, were all the changes visible in the injured bone; but in these cases the fractures had been properly adjusted and retained in position from the first. Might I hint that, to some extent at least, the views to which I have

alluded are the result of misinterpreted facts, observations of experiments on animals, or of what is seen in badly or irregularly united fractures?

When the femora of rabbits or dogs are fractured, and the animals killed to ascertain the changes which occur at different periods after the injury, great extravasation of blood into the tissues, and around and between the broken ends of the bone, is a very marked condition in that early stage; and, somewhat later, inflammatory infiltration of the intermuscular connective tissue, and amongst the fibres of the muscles, is superadded, giving rise to consolidation of the parts around the broken bone, and for some distance beyond. These phenomena are the result of the laceration of texture and irritation produced by unrestrained movements of the broken fragments. Every movement excites spasmodic muscular action, and, consequently, more laceration and irritation, until the extravasation of blood and inflammatory infiltration interfere and prevent the muscles from acting, and, at the same time, serve as a sort of retentive apparatus to the fractured bone.

In badly adjusted fractures, when there is overlapping, or in comminuted fractures, when the fragments render the fractured surfaces irregular, the new material is furnished in larger amount to fill up the inequalities; but even in such cases, not to the extent that the feeling of the mass in the limb would lead us to suppose, for the bulk of that is chiefly due to overlapping; and it not unfrequently happens that, in comminuted fractures, partly detached fragments become imbedded in the muscular or connective tissues of the limb, and the new ossific matter so deposited has led some authorities to assume that the extravasated blood has become organised and ossified. Now, whilst the conditions seen in the experiments on animals or in irregularly adjusted fractures may, if you like, be termed provisional, inasmuch as they help Nature's unassisted efforts towards repair under disadvantageous circumstances, I do not believe in such provisional callus being formed when the fracture is well adjusted and retained in position, and muscular action prevented. Nature is not capricious: the healing process is the same in bone as in other textures; the smallest amount of new material is used for reunion. Just as a wound of the soft parts heals with a fine linear cicatrix, if its surfaces be carefully adjusted and retained and undue excitement prevented; whilst a similar wound, left to itself and subjected to irritation from movement or other causes, inflames, suppurates, and heals by broad irregular scar: so in fracture, if properly set and treated, there will be no ferule or mass of provisional callus at the fractured point.

In a properly-set fracture, I repeat, there ought to be little swelling, and no provisional callus (plate xv. fig. 4). What we see in the case of a fracture in the lower animals, in experiments made on them, is simply the natural process of cure. The blood effused is of use in preventing the action of the muscles, which would otherwise cause further displacement; but the clot is of no use in forming new bone. Some hold that the union of the ends of the bone is due to the clot of blood thrown out between them becoming ossified, and that the large osseous mass thus formed makes the bone stronger than ever. The

Plate XV

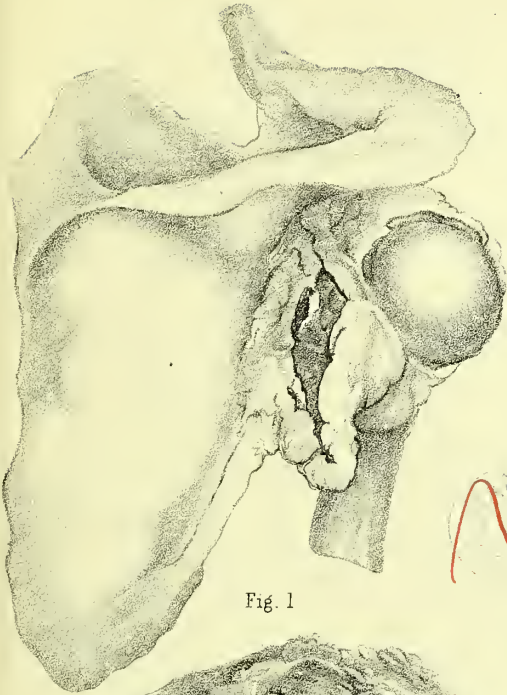


Fig. 1

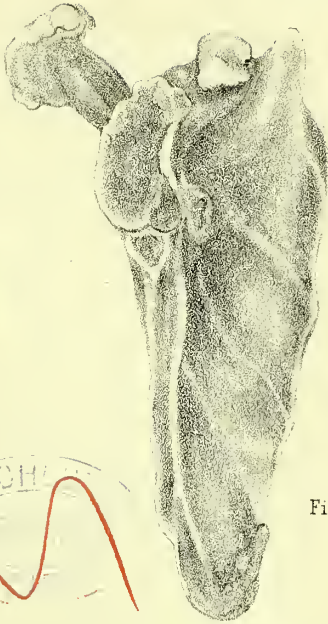


Fig. 2

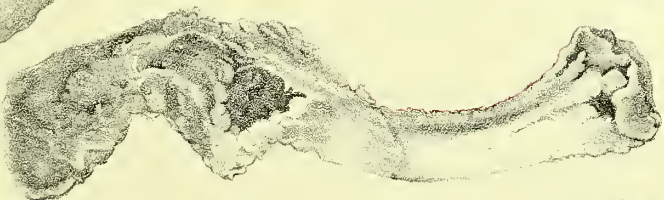


Fig. 3

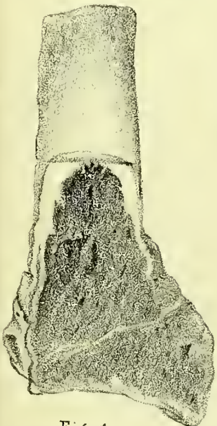


Fig. 4

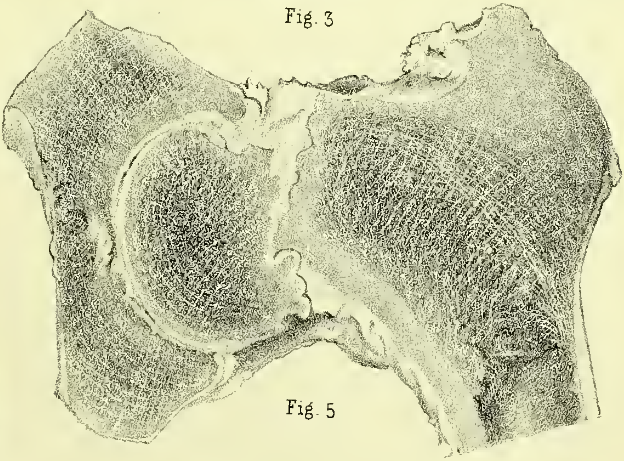


Fig. 5

Waterston & Son Edin. Lith.

apparent thickening of the bone, however, at the point of union is really due to overlapping of the fractured ends, and the new osseous material is merely thrown out to fill up inequalities. They likewise maintain that the medullary canal becomes re-established, and the circulation is again carried on through it, so that, excepting the thickening at the fractured point, we could tell no alteration in the bone. If, however, we look at a fractured bone, no matter how long after the injury, we see that the medullary canal is never re-established, but that at the fractured point there is always a septum, a line of dense bone, which can in all cases be recognised; the Haversian structure has become condensed and ossified at the fractured point, where the new material was thrown out between the ends of the broken bone.

These considerations are important practically, for if we trust to the provisional callus and a certain amount of swelling being present in all cases, we are very apt to have badly set and imperfectly united fractures. If, on the contrary, we treat the fracture as we do a wound, by keeping the ends of the bone in accurate contact—a small amount of new matter only being thrown out to unite the bone—we will have well-set and firmly united fractures. The fracture should be set at once, and the fragments kept in position by proper retentive apparatus, and means taken to modify any inflammatory action which may arise.

LECTURE XLIII.

Comminuted Fracture, dangers, treatment—Compound Fracture—Importance of considering the kind of force causing the Injury—Question of Primary Amputation —Risks of Pyæmia and Gangrene—Question of Secondary Amputation—Complications in Fracture.

In the Comminuted Fracture the bone is broken up into more than one portion. Even in the simple comminuted fracture, where there is no wound of the soft parts communicating with the fractured point, the danger and difficulty in treatment are much greater than in the simple fracture; and the greater the amount of comminution, so much the greater are the dangers and difficulties of the case. When the bone is broken into a number of small fragments it is very difficult to keep them all exactly in position, or indeed to get them rightly placed at first, especially when there are any small fragments lying across the direction of the fracture. There are, moreover, dangers in the after-progress of such a fracture, both as regards the limb and otherwise. There is, first, the risk of the irritation produced by the fragments lying between the ends of the bone, tearing the muscles and other textures, and so acting as an obstacle to union. Again, portions of the comminuted bone are sometimes so completely detached by the violence of the force causing the injury that necrosis may follow. When this takes place, inflammation is excited by the dead bone acting as a foreign body, and suppuration sets in, which may lead to serious results, from the long-continued discharge and the difficulty of getting rid of the necrosed bone without interfering too much with the fracture. Where necrosis occurs in this form of fracture, when considerable portions of dead bone are removed, there is of course a loss of substance in the bone, so that extension and counter-extension cannot be well kept up; there must be more or less shortening of the limb, and there is thus a greater risk of deformity after a comminuted than after a simple fracture.

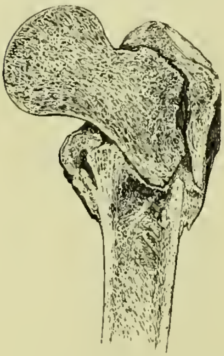


Fig. 42.

Under the heading of comminuted fracture we may also consider another variety of fracture, called impacted fracture (fig. 42). Here the fragments are jammed together in such a manner that certain of the best marked symptoms of fracture may be absent. There is deformity and shortening, but there is no unnatural mobility at the site of fracture,

Fig. 42. Impacted Fracture.

and unless there is a considerable amount of comminution we may be unable to detect any crepitus.

As to the treatment of the simple comminuted fracture. In the slighter cases there may be no great difficulty in setting the bone properly at first; but if the bone is lying loose, and broken up into minute fragments, we should try to model the limb as near as possible into the natural form. The limb is therefore extended and counter-extended; and if there be any portions of bone lying laterally, we must try to bring them into line with the natural axis of the limb. When the limb is thus modelled as much as possible to its natural form, it is then placed in a splint, and here a particular retentive apparatus is applied for each special fracture. In such a fracture, of the leg for example, Liston's splint, or the double inclined plane, answers best (plate xvii. fig. 5). The thigh and leg are kept nearly at a right angle with each other, the foot being fixed and extended, and the whole is kept in position by slip-knots or a circular bandage. The general modelling of the limb is looked to from time to time; and if there be any tendency to alteration, small splints are put on laterally, and the case must be watched carefully for some time.

If the injury has been caused by great direct violence, there is a greater risk of the fracture becoming a compound comminuted one, by inflammation and suppuration, or by sloughing. As regards the after-treatment of the case, if there be any inflammation, a cold or tepid water-cloth is applied on the surface for a time. The splints must be kept carefully applied, and the part left open, so that it may be dressed easily, and in this way, if there be not much fever, comminuted fractures often do very well.

In some cases we find that we cannot bring the parts into position so well as we could wish, small pieces of bone slipping out as soon as they are adjusted. When this happens, we should content ourselves with merely maintaining the general position and length of the limb, and not meddle with the parts too much at first, but rather wait for a week or ten days till a certain amount of plastic exudation has been thrown out, and then model the bone properly, for now the exudation will keep the small fragments of bone together. The general position of the limb should never be altered, the two great portions of the bone —the lower and the upper—should be adjusted at once, and always kept in a line with each other; but we should not meddle too much with the intermediate comminuted fragments, as that may cause too great irritation. Opiates should be given to allay the pain, and attention to diet is essential. In comminuted fracture of the cancellated bones of the foot, the comminution is very great. Inflammation and necrosis of part of the bone very often take place, requiring amputation to be performed, though in some few cases this may not be required.

In Compound Fracture (plate xiv. fig. 2), there are peculiar dangers which must be specially attended to. It may seem strange that a simple wound communicating with the fractured bone should make so much difference, and cause so much danger, but so it is; and even a comparatively slight fracture, communicating with an external wound, is always

more dangerous than a simple fracture, or a simple comminuted fracture.

We must look at the dangers of compound fracture in connection with the fact that the wound communicates directly with the bone, and the nature of the violence causing the injury. If the fracture be caused by direct violence, making a wound down to the bone, we cannot wonder at the danger, for here there is very great force, not only breaking the bone, but also destroying the soft parts covering it, giving the character of a contused wound, and sometimes of a lacerated wound. If the fracture be caused by a sharp instrument, then there is the least amount of danger to the patient, for here there is more the character of an incised wound. Even if a joint be implicated in such a case, the patient may do very well, notwithstanding the important parts injured; but then, from the injury being inflicted by a sharp instrument, directed with great force, the soft parts and the bone are all cut through rather than broken. In cases of compound fracture from a cart-wheel or railway-truck passing over the limb, there is the greatest amount of force causing the injury. The parts are much bruised, and the bone broken up; and even though the fracture be not very severe, the other conditions, the laceration of the nerves and vessels, and of the soft parts generally, will cause great danger. When the fracture is caused by a weight falling on the limb directly, and breaking or bursting through the soft parts, the effects are the same, though not so severe as in the preceding case. Where the fracture is caused by the patient falling or jumping from a height, the bone being projected through the soft parts, we have perhaps the minimum amount of danger. The soft parts are torn through when they are tense, by the sharp end of the bone, so that there is comparatively little bruising or laceration, and often the periosteum is not much torn. As a general rule, cases of this kind present less danger than other compound fractures. In all compound fractures we must look to the force causing the injury, in order to estimate properly the dangers of the case.

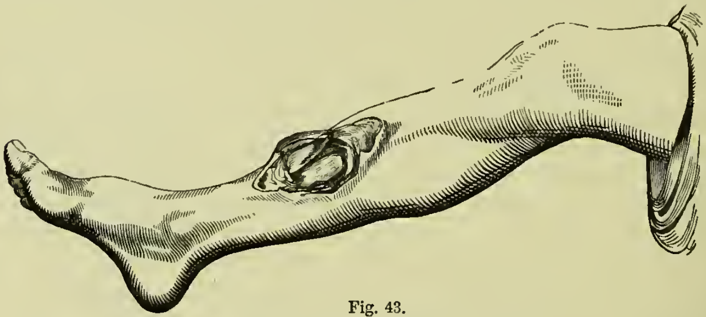


Fig. 43.

In the compound comminuted fracture (fig. 43) there is another danger added from the comminution of the bone, and, generally, the force causing this injury is very much greater than that causing the more simple fractures. We must not estimate the danger of a compound fracture by the size of the wound accompanying it; the

Fig. 43. Compound Comminuted Fracture of Tibia.

fracture may be very dangerous, and the soft parts around it very much injured, though the external wound be very small. In other cases there may be a very large external wound, and a serious fracture of the bone, which may heal comparatively readily—the very extent of the wounded surface really diminishing some of the danger by preventing the tension and inflammation which might otherwise arise.

The specialties of treatment in compound fracture are the different forms of apparatus, so applied that the wound may be dressed readily, whilst the fragments of bone are kept constantly in position. In fracture of the leg, for example, it is laid on the double-inclined plane (plate xvii. fig. 5), so that the greater portion of the limb is exposed. The foot, knee, and thigh are fixed, but the whole of the anterior portion of the limb, and both sides of it, are exposed, so that the wound can be very readily dressed. In fractures of the thigh, if the wound be on the outer side of the limb, the two portions of the long splint are connected by an iron hoop over the wound (plate xiii. fig. 4). Extension is thus kept up, while the wound can be easily dressed; the splints must of course be altered according to the position of the wound and the site of the fracture. If the wound of the thigh be at the side, we may use the anterior and posterior splints as well as the long splint. The use of the pulley extension method still further simplifies the treatment, as in that method there is nothing to interfere with the dressing of the wound.

The general symptoms must be carefully attended to. The state of the wound and of the soft parts must be constantly noticed, and care taken that no undue pressure is caused. When the shock of the injury has passed off, we must ascertain the state of the great bloodvessels, to see that there is no interruption to the circulation in the limb. This must be done even in some cases of simple fracture, for an artery may be torn without much effusion of blood at the time. If this has occurred, the parts will become livid, and would soon become gangrenous. A considerable amount of irritative fever generally follows on the fracture, but this symptom usually passes off. In other cases suppuration and rigors come on; the tongue, however, is not foul, but the rigors become more frequent and pyæmia sets in. This is a condition which is not sufficiently insisted on in surgical works. In deciding on amputation in compound fractures, we are told of gangrene, of necrosis, and of the long continued discharges; but more important than these is the fact that pyæmia may ensue, even though the fracture may not seem a very serious one; and when pyæmia does set in we cannot interfere, for amputation then would simply hasten the death of the patient.

In regard to general regimen, we must give non-stimulating diet at first, along with iron and other remedies of that kind, with a view to ward off bad results.

In estimating the question of amputation in compound fracture, we must first consider the possibility or the probability of saving a useful limb, and in this we must be guided by the amount of comminution of the bone and the injury to the surrounding soft parts. If we require to remove large portions of comminuted bone lying quite separate from the other textures, where there must therefore be much shortening of

the limb, should the chief vein or artery be injured, in such a case, even if the limb were saved, its vitality will be much lessened; and sometimes, from the amount of shortening, it will be worse than useless; while in most cases of this kind, the limb, such as it is, will only be saved at great risk to the patient's life. If we consider that the risk to life is greater than the probability of saving a useful limb, we are quite justified in performing amputation; but the amount of force causing the injury must always be kept in mind in deciding in each case. We should also remember that pyæmia is very apt to supervene, and that the risk to life from this cause is very great, while the chance of saving the limb may be very small. In other instances, the patient may be determined to run considerable risk rather than submit to amputation. In all cases where the upper limb is concerned, we should remember that here the risks are less, the vital powers are greater, the management of such a fracture is easier than in the lower extremity, and the chances of saving the limb are therefore greater. Moreover, if we save the hand and wrist, even though it be deformed, still it is more useful than any artificial limb which can be obtained; while in the lower limb, on the other hand, the risks are greater, and the saved limb may be less useful than an artificial one. The risks of gangrene must be considered in connection with the degree of force causing the injury, and the age and constitution of the patient must also be kept in mind. In old persons, and those in middle life, the chances of success are less than in younger patients, especially those under adult age, who possess greater vitality than older persons. In the young, even though a considerable extent of bone be lost, a large amount of new bone is thrown out, filling up the vacant space, and so leaving a pretty useful limb.

Secondary amputation is sometimes required in compound fracture. Spreading gangrene may necessitate it, but this has been spoken of before under the subject of mortification. Where there is necrosis of the bone, with long-continued suppuration from any cause, when the patient's health is giving way, whenever hectic supervenes, and when the limb would evidently not be a useful one if saved, then secondary amputation ought to be performed. As a general rule, secondary amputations for injury are by no means so successful as primary ones, and hence the necessity for the surgeon making up his mind at first whether to amputate or not. In these cases irritative fever is often present, and this should be considered, as in such cases the stump takes on an unhealthy action and pyæmia is likely to follow. In compound comminuted fracture the rules for amputation are the same, but here we have one advantage over the simple comminuted fracture as regards local treatment, for we can readily remove any loose portions of bone through the wound, and thus often save a very serviceable limb.

As regards the different complications of fractures, it would be endless to enter on them, for they vary so much. We may have a case where, from the direction of the wound, the limb would require to be kept in one position, and in another position for the union of the fracture. No general rule can be laid down for the treatment of such cases, and each must therefore be treated according to the particular conditions which may be present.

LECTURE XLIV.

Failure of Union—Causes, Local and Constitutional—Condition of the Bone in such cases—False Joint, Methods of Treatment—Subcutaneous Section—Seton—Resection—Dieffenbach's Method—Injuries of Texture resulting from Dislocation—Process of Healing when Reduction is immediately accomplished—Refracture of a badly United Fracture—Alteration of Structure in cases of Old Unreduced Luxation—Importance of these Changes in regard to Practice—General Rule as to the Period and Conditions under which Reductions may be attempted in Old Luxations.

SOMETIMES the union of a fractured bone fails. NON-UNION of fracture, or the occurrence of ununited fracture, depends on a variety of circumstances. In the first place, it may depend on improper treatment. The surgeon not having been quite sure at first where the fracture was, may meddle with it from time to time, and then the chances are very much against the fracture uniting. Constant movements of the limb by the patient are also a very frequent cause of the non-union of fracture. These belong to the class termed unavoidable; but although unavoidable on the part of the surgeon they are not unavoidable on the part of the patient, therefore the term is an improper one. The limb should be well set at first, and kept in a position by proper retentive apparatus, and not much interfered with afterwards.

It is not powerful movements of the limb which cause non-union. The patients seldom do much harm in the first fortnight, when there is still some pain, but after that there is a strong inclination to move the limb slightly. In the upper extremity patients have then a great tendency to use the fingers, and to prevent this we generally use splints for two or three weeks, which pass beyond the fingers both in front and behind. In fracture of the upper arm we are sometimes obliged to put on splints over the forearm to prevent the wrist and fingers being moved, especially if it be a fracture of the humerus close to the elbow, where movement of the wrist would keep the lower end of the humerus constantly in motion. Absolute rest of the fractured bone is essential to union, and for the purpose of enforcing this we apply retentive apparatus, which secures not merely the broken bone but also fixes the neighbouring articulations, and in fracture of the arm the fingers must also be kept fixed, especially in restless patients, as in children. Independently of these movements, there are other causes which may induce non-union. Even in a simple fracture a portion of muscular texture may be nipped up between the broken ends of the bone—in oblique fractures this is not uncommon—and if this portion of muscular texture be not removed from between the ends of the bone, union is not likely to occur. According to those who believe in the blood-clot forming the provisional callus, this piece of

torn muscle ought to be of great advantage in the consolidation of the bone, but the fact is that it really prevents union. In comminuted fracture, where there is a large portion of bone removed from its periosteum, and where there is a deficiency of structure, we can easily understand how the ends of the bone, instead of approaching each other, may become rounded off, and then osseous union will not take place. Again, where suppuration and necrosis occur, the loss of substance and the exhaustion of the patient may lead to non-union; but this is a very rare cause of it, for where the bone has necrosed new bone is thrown out to take the place of the portion which has been removed. There are also other local causes of non-union, such as the destruction of the vitality of the textures around, as when the fracture has been caused by very great force.

Non-union may also occur from impaired vitality of the part, as where the bone is broken in two parts with a portion between them, thus forming a comminuted fracture. In such cases it very frequently happens that the bone unites at one part but not at the other, and if the foramen for the nutrient artery of the bone be implicated in the injury, there is less chance of union in the deep-seated part of the fracture.

The general constitutional causes of non-union of fracture may be stated as being debilitating causes of any kind, such as long-continued discharges, where the health is exhausted and the reparative powers are injured. In syphilis, from the cachexia existing in certain tertiary forms of the disease this want of reparative power may cause non-union. Scurvy also may prevent union, and may even cause the union which has taken place to give way; this has been mentioned before when speaking of the scorbutic ulcer. The previous habits of the patient, or excessive natural discharges, as in cases of menorrhagia, often impair or frustrate the uniting process. Another general cause of non-union is pregnancy; when a larger amount of blood than usual is directed to one organ for a time, the reparative power seems to go on in the other parts less perfectly; still I cannot say that I ever saw, in my own experience, a case of non-union of fracture occurring in a pregnant woman, though such cases have sometimes been met with.

When union does not occur, we may have two or three different conditions of the broken bone. We have sometimes simply non-union,

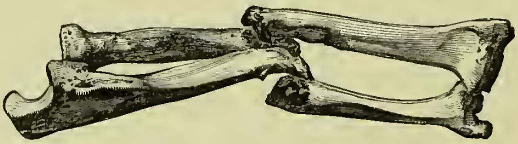


Fig. 44.

as when a portion of necrosed bone prevents it, but where, after removing this dead portion of bone, union takes place. In certain cases whilst osseous union does not take place, there may be a certain amount of fibrous texture uniting the ends of the bone, and so forming one kind

Fig. 44. False joint in the fore-arm. The bones play on each other by a new hinge-like joint.

of false joint. In other cases the ends of the bone are atrophied, rounded off, covered with glistening fibrous tissue, and connected with each other by a fibrous capsule, continuous with the periosteum of the broken bone, thus allowing free movement, and forming the most perfect example of false joint (plate xv. fig. 3). (Fig. 44.)

Various methods have been adopted to bring about union in these cases. The constitutional treatment is important, and here one condition in particular should be attended to. In patients with fracture of the lower extremity, we may find that at the end of four weeks or so there is little or no union, even though the patient has had full diet without stimulants. If the patient has been in the habit of taking stimulants the fracture is not likely to unite so long as he is deprived of them, and even when he has not been much accustomed to them it is often necessary to give stimulants to produce union of the fracture. If we take down a fracture at the end of five weeks, and find it not united, we should then carefully reapply the retentive apparatus, fix the parts in every direction, keep up moderate extension, and then retain the limb unmoved for some time. Even here I do not like the use of the starch bandage, for it is very apt to get loose, instead of fitting firmly to the limb; and hence I prefer an ordinary bandage, the condition of which can be easily seen. By carefully reapplying the retentive apparatus, and paying proper attention to diet, etc., such a fracture will often be made to unite, but not always; and then what is to be done? One plan of treatment which I have found very useful is a method proposed by the late Professor Miller—namely to tear up, subcutaneously, with a long narrow but strong knife the fibrous texture on the ends of the bone, and so expose again the osseous structure. The periosteum should also be torn up for some little distance beyond the fracture, so as to excite some irritation. The retentive apparatus is then reapplied very carefully, and the limb kept in position for several weeks, and under this treatment I have found many ununited fractures unite perfectly. This method of subcutaneous incision and tearing up of the fibrous texture ought, I think, always to be tried before having recourse to any of the more severe methods of treatment; but to be of any use it must be done thoroughly—we must tear up the fibrous texture completely, and feel that the needle is between the ends of the bone. We should also tear up the periosteum for some little distance, so as to excite action in it and cause the deposition of earthy matter from its interior, and so give a better chance of consolidation.

When this method fails to bring about union, we must then adopt more severe measures. The most general method used to be the introduction of setons. An incision was made down upon the ends of the bone, and a seton passed between them, and brought out on the opposite side of the limb, taking care, of course, to avoid the great vessels and nerves of the limb. The object of this was to excite action. The seton was left in, till some inflammation and suppuration came on, and was then removed. It ought to be left in only till excited action occurs, for otherwise there is danger of acute necrosis of the shaft coming on, and in some cases this simple operation has led to amputation. On the withdrawal of the seton the retentive apparatus should

be again applied, and the parts kept perfectly fixed for some time. This simple-looking operation of passing a seton between the ends of the broken bone was often attended by very serious consequences, such as necrosis of the bone, suppuration and irritative fever, and even the death of the patient, and very generally it was found that union had not taken place, and that the parts were still movable.

The next plan is that of resection of the bone. It is generally found that in the worst cases of non-union the ends of the bone are atrophied, and only approach one another without having any tendency to unite. In the treatment by resection, an incision is made over the fracture, the ends of the bone laid bare, and an inch or so is sawn off each end. The ends of the bone are then replaced, and the limb put up again in the retentive apparatus. This is practically turning a simple fracture into a compound one; and in many cases, necrosis, suppuration, irritative fever, and pyæmia come on, and often amputation of the limb has to be performed afterwards. A modification of this plan, however, is the one which I still have recourse to as a last resort. In 1854 * I published a case in which I had carried out the treatment on a principle of my own. It was a case of non-union after fracture of the humerus in a young man. In this case I removed the ends of the bone, which were atrophied and rounded off, but not with the saw. I merely snipped off the rounded ends of the bone with the bone-pliers, so as to remove only a very small portion of bone, and this was done without lifting out the bone from the soft textures. In this case the union of the fracture took place in about six weeks, and I have since employed this method successfully in several cases, though not in all in which I have tried it. The principle is one in which I have great confidence. The less disturbance of the soft parts and of the broken ends of the bone the better, and the less bone removed the better. Besides, the resection with the bone-pliers resembles a fracture more closely than that made with the saw.

All cases of fracture, however, are not suitable for resection, and then another method of treatment may be adopted, but the plan is only applicable to certain forms of fracture—namely, oblique fractures. This plan consists of the introduction of pegs into the fracture so as to keep the ends and surfaces of the bone fixed together, and also to excite action in the bone. An incision is made over the fracture, and a hole is bored through the ends of the bone which are overlapping each other without being united; a steel or an ivory peg is then introduced into the hole, and the ends of the bone are thus brought firmly into contact. This plan was first adopted by Dieffenbach, who, noticing that the presence of a piece of necrosed bone caused a great deal of action in the part, thought that by making the ivory peg represent the necrosed portion of bone the same amount of action would be excited, and the peg could be removed afterwards like the necrosed bone. The principle and the reasoning are good, and in certain cases of oblique fracture this plan has met with success, but still it has not been so successful as might have been wished. The pegs sometimes give rise to irritation and acute necrosis of the bone without causing union, still

* See Clinical Cases at end of this section.

it is a method which I would have recourse to after all other means had failed to cause union, especially in oblique fracture of the tibia, where the bone is so superficial. At first sight the plan looks absurdly mechanical, but the principle of it is good—namely, to excite action in the bone, and not merely to keep the parts together mechanically.

These are the principal methods of treating ununited fracture, but the slighter operations should be tried first, especially the subcutaneous method of incision, and that failing, the removal of merely the ends of the bone with the bone-pliers.

We must attend carefully to constitutional treatment, for without that all the other means will fail.

Refracture and readjustment of a badly united fracture, when the bone has thoroughly consolidated, is a proceeding which, although popularly believed to be frequently resorted to by surgeons, is one which has been rarely practised since the beginning of the present century. Readjustment, however, by bending over the knee, or by pressure and counter-pressure in the case of deformed and recently united fractures, has often been effected; but interference with a badly united fracture, after months have elapsed, has generally been regarded as improper, and likely, from the force required, to lead to serious risk, with little chance of restoring the limb to better form or usefulness. Yet in early surgery, refracture seems to have been a common proceeding amongst Arabian surgeons. Abulcasis, who objected to the practice, reprobates it in strong terms: but if his remedies for softening and diminishing exuberant callus failed, this same Abulcasis had no hesitation in recommending resection of old fractures. "If the distortion be old and firm," says he, "cut across the bone and saw off all that is superabundant, whether of the bone or callus." And he further remarks to his pupils, "that study and practice will make them very expert in the operation." Here we find ourselves coming back to old methods, for amongst our most recent advances, more especially since subcutaneous and subperiosteal operations have been introduced, resections to remove deformity resulting from anchylosis or badly set fractures have been practised with much advantage. The operative proceedings have been varied—sometimes weakening the point wished to be broken—by drills, or narrow saws or osteotomes, sometimes by direct section by saws or chisels. Even yet, however, the cases are rare in which surgeons have ventured to break thoroughly consolidated fractures by direct force to remove deformity. No doubt, when we think of the degree of force to be applied, and look at the apparatus necessary for the purpose, a feeling of repugnance arises in the mind; but some things look worse than they really are. I make these remarks in reference to a method of refracture and readjustment of old badly-set fractures of the femur, introduced to the notice of the profession by Mr. Butcher of Dublin. Mr. Butcher's case was a fracture of the thigh, attended with great deformity and shortening, in a young man who had met with the injury upwards of six months before he consulted Mr. Butcher. Any one who looks at the photographs of the limbs in that case before and after the operation of refracture, will, I think, agree with me, that it is a triumph of surgery. But when

you look on the actual apparatus by which this triumph was obtained, you might be inclined to use the language of John Bell in reference to some ancient apparatus, that it was "an engine of torture fit only for the Inquisition." I have, however, had an opportunity of testing this apparatus, and can state to you that it produced none of the torture or bad effects its appearance might suggest. It happened that at the time I received Mr. Butcher's account of his case of refracture, I was considering that of a patient who had come from the backwoods of Canada to consult me, and ascertain if I could do anything for deformity and great shortening of the limb, resulting from a fracture of the femur he had sustained about two years before. The limb was four inches shorter than the sound one, and a large knee of bone projected, giving rise to great deformity; and, what was worse, the peroneal division of the popliteal nerve had suffered, and the extensor and peroneal muscles were paralysed. The case was most unfavourable, both as regarded the form of the fracture and the length of time it had been consolidated, whilst the paralysis of the foot made me doubtful of any interference; but, seeing that he had come a long distance as a last hope, I determined to try what could be done.

By using galvanism after dividing the tendo Achillis, some increase of muscular power and development was obtained, and I had made up my mind to partially resect the fracture with a narrow saw, and then break it through, when the report of Mr. Butcher's case was opportunely sent me. On carefully and anxiously studying it, and communicating with Mr. Butcher, I had his apparatus made and refractured the bone; and though, owing to the unfavourable nature of the case, the result will not compare with Mr. Butcher's, yet the operation has greatly improved the length and form of the limb, whilst the patient suffered no constitutional disturbance, and scarcely any local irritation from what seemed an application of great and direct force.* That the apparatus admits of much modification and improvement to adapt it for acting on different forms of fracture I doubt not; but its efficiency and safety even in its present form has I think been proved, and, although the necessity for such operations is daily diminishing, owing to the advance of surgical skill, yet, in cases such as those fractures which occur when the patients are at a distance from medical aid, it is well to have it in our power by simple and safe means to remedy these terrible deformities even after some time has elapsed.

I now proceed to notice briefly the changes which take place consequent on DISLOCATION as contrasted with those after fracture. When a bone is dislocated a considerable amount of injury is caused to the connecting ligamentous textures. In the case of the capsular joints, such as those of the shoulder and hip, we have the proper capsule of the articulation torn through at its weakest point, generally towards the lower or inner part of the capsule, and the muscular textures are also injured. At one time it was supposed that dislocation might take place without this occurring. It was thought that simply from the elongation of the elastic fibres the head of the bone might escape from

* See Clinical Cases at the end of this section and the figure accompanying the case.

its articulating surface without actual rupture of the ligamentous texture; but no practical surgeon, so far as I know, ever believed in it; it was merely a theory. We find that in all cases the ligaments are ruptured, and sometimes even the capsular muscles torn from their insertion, by the degree of force causing the injury. If the head of the bone be reduced at once, the capsule and the other soft textures heal by the process of adhesion, though the cicatrix will not be so strong as the natural texture. In the hinge-like joints the lateral ligaments sometimes give way, but seldom so completely as the capsular ligaments. In the elbow-joint, for example, it is simply the anterior and posterior ligaments which give way and allow of the displacement.

When the dislocation is reduced, as a general rule the capsule heals, and the use of the limb is perfectly restored. If, however, a dislocation has been left long unreduced, the joint remains stiff for some time, but afterwards the mobility increases. The movements, indeed, are not the natural movements of the joint, but they allow the patient to move the limb to a considerable extent, and it becomes tolerably useful. If such a patient be brought to a surgeon, reduction should hardly be attempted if the joint be very movable, for the chances are against reduction being accomplished. The fact is, that a new articulation is being formed, and this accounts for the movements being so free. The surfaces of the bone always become more or less altered. The glenoid cavity, for example, becomes sometimes reduced to a semilunar form (plate xv. fig. 2), part of it, and also of the head of the humerus, being marked by a porcelaneous deposit. A new joint has been formed, so that it would be of no use to reduce such a dislocation, as the glenoid cavity has become altered in shape. So also when the head of the radius has been dislocated backwards, the joint becomes completely altered in form, and the head of the radius is also altered; and here too it would be useless to attempt reduction, for the natural movements of the joint could not be restored.

Whenever we have a dislocation long unreduced, where there is considerable motion of the joint reduction is contra-indicated. In ordinary cases reduction may be attempted in the dislocations of the hip or shoulder joints, even after some months, while in joints like the elbow reduction after a few weeks is excessively difficult, often impossible.

The *Treatment* of luxation is termed reduction, and consists in restoring the dislocated bones to their natural position. This process is effected by forces applied generally in the form of extension and counter-extension, and kept up until the object is attained. Counter-extension consists in fixing the articular surface nearest the trunk, so as to prevent it yielding to the extending force employed to act on the dislocated bone. It is usually managed by means of a sheet or laque, or the hands of an assistant, or by the surgeon placing his knee or foot so as to fix the part, whilst he makes extension with his hands, or by means of pulleys, according to the degree of force required. Extension is usually made by drawing down the dislocated bone in the axis in which it has been displaced, whilst at the same time the foot or knee which is used to fix the articular surface from which it has been dislocated is also made to form a fulcrum, over which the shaft of the

luxated bone is made to act as a lever to raise its articular extremity from its abnormal position, and bring it within the action of forces which tend to replace it. In other cases, instead of using extension, the reduction is accomplished by fixing the trunk, and then moving the luxated bone in such a manner as to tilt its articular extremity from the abnormal position, as in the instance of luxation of the femur into the obturator foramen. The amount of force required will vary according to the nature of the dislocation and the length of time it has remained unreduced.

Formerly preparatory treatment required to be used to overcome opposing muscular power. The warm bath, venesection, antimony, and tobacco enemata, were used for this purpose. The use of chloroform has now completely superseded these debilitating preparations for reduction, as under its effects all muscular resistance is got rid of, and hence reduction of dislocations, except in old unreduced luxations, is now a comparatively easy procedure. Various mechanical contrivances have been used to afford increased power in reducing old dislocations. The simplest and most efficient of these are the pulleys, or block and tackle. A laque of worsted is fastened round the lower part of the dislocated limb in the form of the "clove-hitch," and the hook of the pulleys is fastened into the free ends of the laque. Before applying the worsted laque, a wetted bandage should be rolled round the limb at the part where it is to be applied, so as to prevent the traction causing excoriation of the skin, and after the laque is put on above this the remainder of the roller is used so as to fasten the laque still further, to prevent all chance of its slipping. Extension is then made by the pulleys very gradually, whilst counter-extension is kept up by means of a sheet or special apparatus fastened to a ring-bolt in the floor or wall, or to some fixed piece of furniture in the room.

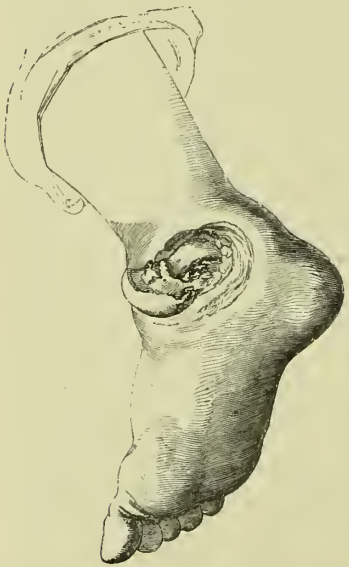


Fig. 45.

The methods of carrying out these general principles will, however, be better inculcated when treating of the special dislocations.

Recently a procedure termed reduction by manipulation has been recommended by Dr. Reid of Rochester, U.S., and has proved successful in several cases. It consists in executing certain movements of the dislocated limb by the hand alone, and has been principally used in dislocations of the hip, and will be described when I speak of these, but it is also applicable to other joints.

Compound Dislocations are very dangerous accidents, more so indeed than even compound fractures, with which they have many features

Fig. 45. Compound dislocation of the ankle joint.

in common. In some favourable cases, in young persons, by immediate reduction, closing the wound accurately, and applying carbolic oil covered with gutta percha, or varnishing over the wound with collodion, or similar medium, so as to exclude all external sources of irritation, and by adopting the ice treatment recommended for wounds of joints, together with careful after-treatment, we may save a useful limb. In most cases, however, either primary resection of the joint, or amputation, if the surrounding textures be much injured, requires to be performed. In patients above middle age I believe amputation to be the safest plan; but the surgeon must judge of the conditions in every individual case. I would refer you to what I have already said on the subject of wounds of joints, and lacerated, contused, and gun-shot wounds, as bearing on this subject, and as enabling you to decide on operative or other measures in the treatment of compound luxations.

LECTURE XLV.

Fractures of the Clavicle—Symptoms and Causes of Displacement—Treatment—Dislocations of Clavicle—At Sternal Extremity—Secondary Dislocation from Disease of Spine, and Operative Measures required for its relief—At Acromial end—Appearances somewhat resembling Dislocation at Shoulder Joint—Prognosis and Treatment—Fractures of Scapula—Fracture of Neck, simulating Dislocation into Axilla—Treatment.

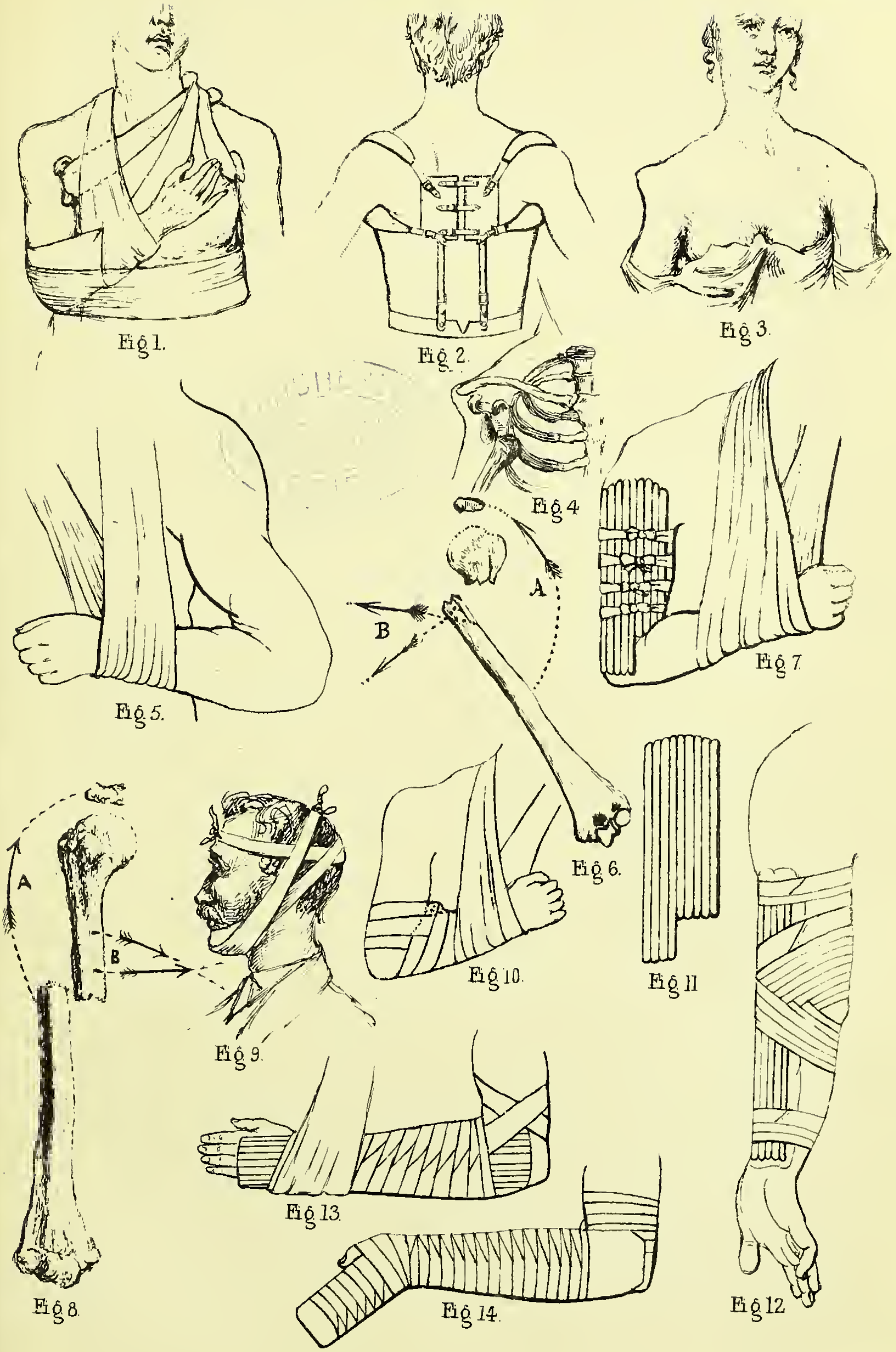
THE CLAVICLE may be broken at different parts, according to the direction of the force which causes the injury, but the point of all others where it usually gives way is just a little to one side or other of the middle of the bone. When fracture occurs at this part the displacement is very marked. The outer end of the sternal portion of the bone projects, and appears to be drawn upwards. The shoulder falls down, and is drawn forwards and inwards towards the chest, so that the axillary space is diminished in size. The patient generally keeps the arm semi-flexed, and supported by the opposite hand. The slightest movement of the shoulder causes intense pain. The patient can usually make out the diagnosis of the injury himself. The symptoms, then, are—projection of the outer end of the sternal portion of the bone, depression of the acromial end, falling-down of the arm, and pain on movement of the parts.

The causes of these symptoms are first and principally the weight of the arm bearing on the scapula and the acromial end of the clavicle, and so dragging down the outer fragment. The internal, or riding end of the bone, is little, if at all, displaced; it remains equipoised between the clavicular attachment of the sterno-mastoid above, and the clavicular fibres of the pectoralis major and the rhomboid ligament beneath, so that the muscular forces are nearly balanced. The muscles attached to the scapula and humerus, and outer fragment of the clavicle—the pectoralis major and minor, the latissimus dorsi, teres major and subclavius—tend to drag the arm and shoulder downwards and inwards towards the chest. The appearances, therefore, of the narrowing of the chest, and the riding of the bone, are readily accounted for—the principal displacing cause being the weight of the limb. When we lay the patient flat on his back in bed, and raise the elbow, the fractured bone is easily returned to its normal place; and if the patient were kept always in this position, no other treatment would be necessary than to keep the arm fixed across the chest.

The clavicle may also be broken very near its sternal end, sometimes quite close to the articular surface, so that the injury may re-

FRACTURE & DISLOCATION

Plate XVI



semble very closely a dislocation of the clavicle from the sternum. In this fracture the displacement is downwards and forwards. The shaft or outer part of the bone has its inner end drawn inwards upon the sternum by the subclavius and pectoral muscles acting on the clavicle and arm. The broken end of the bone can be distinctly felt moving on the sternum, as if it were dislocated, but the fractured surface and the crepitus on reduction distinguish this injury from a dislocation. The movement of the broken end of the shaft in front of the sternum causes considerable pain to the patient. Any movement of the arm also causes pain. The fracture, therefore, is easily recognised, and the treatment very simple, all that is necessary being to reduce the fracture and keep the parts at rest in the proper position for two or three weeks until union has taken place. Fracture at this site is, however, much rarer than in the middle third of the bone.

The clavicle is also sometimes fractured between the two portions of the coraco-clavicular ligament—in the interval lying between the conoid and trapezoid. The injury is generally caused either by a direct blow on the bone at or near the point of the shoulder, or by a counter-stroke received in falling upon the shoulder. This accident is attended with very little displacement, either primary or secondary. When the fracture occurs exactly between the two portions of the ligament, there is little if any displacement, for the ligamentous textures keep the two ends of the bone so far fixed to the scapula and to each other. But it is very seldom that we find the fracture corresponding exactly to that interval. The more general site is a little external to the conoid and trapezoid ligaments, and therefore beyond the reach of their direct counteracting influence, so that the resulting displacement is often considerable. There is no difference in the level of the bone, but the fractured ends are displaced in the antero-posterior direction. As the displacement does not occur immediately, this makes the fracture more difficult of diagnosis. There is often no alteration visible at the time of the accident, but great deformity may arise subsequently, if the fracture be not recognised and treated at first. You will be best enabled to do this by running the finger along the line of the bone, and placing it deeply over the seat of pain. Then, by fixing and rotating the scapula and humerus, you will generally be able to make out a deep-seated crepitus.

Fracture at this site is by no means uncommon. It is met with less frequently than fracture of the middle portion, but oftener than at the sternal extremity. As I have already stated, it occurs generally beyond the outer portion of the coraco-clavicular ligaments, and leaves them, therefore, undisturbed in their position. The active displacing agents will be evident to you. These are partly muscular, and partly due to the weight of the arm. The shoulder is drawn inwards, and becomes narrower. It does not droop much. The outer portion of the bone becomes gradually drawn round, until it lies in an antero-posterior direction to the shaft. This arises from the pectoralis minor, assisted by the rhomboidei muscles rotating the scapula, so as to depress and draw forwards the point of the shoulder, together with the outer fragment of the bone. The rhomboideus major and minor and other

muscles depress and rotate forwards the anterior angle of the bone; whilst the trapezius, which would naturally oppose that action, acts only on one part of the scapula, and tends rather to carry it backwards, so that the acromial fragment of the clavicle is placed at a right angle with its shaft. This causes great deformity and comparative uselessness of the arm. If we put up the fracture at once, keeping the shoulder back, and confining the movements of the scapula, it will unite without much deformity; but if we neglect this, the usefulness of the arm will be much impaired.

Fractures of the clavicle generally mend by osseous union; and if the parts be maintained in accurate apposition, and at rest, the process of repair is completed in a very short time. After union the site of fracture is often marked by a considerable thickening of the bone, and often by a decided deformity. This depends chiefly on the direction in which the solution of continuity occurs. Transverse fractures unite most readily; and the greater the degree of obliquity the greater is the difficulty of maintaining apposition, and the greater the risk of resulting deformity.

The indications of *Treatment* are obvious. They consist in the restoration of the displaced parts to their normal position, and the retention of them there. This is effected by carrying the shoulder upwards, outwards, and backwards. The apparatus employed for this purpose requires to be varied according to circumstances. For fractures at the inner or middle thirds of the bone the axillary pad will generally be found an efficient means to employ; while for those which occur in the outer third, either within or external to the ligaments, it will generally be found necessary to brace back the shoulders by means of a figure-of-eight bandage, or two handkerchiefs, or the special apparatus (plate xvi. fig. 2), which is in reality by far the most efficient method. In connection with the axillary pad three handkerchiefs are used. One is employed for the purpose of securing the pad. It is made to cross over the opposite shoulder, and then tied under the corresponding axilla. The second handkerchief is used for a sling, and the third serves to fix the arm to the side of the body. The arm should be flexed to an acute angle, so that the fingers almost touch the opposite shoulder (plate xvi. fig. 1). Various ingenious mechanical contrivances are in use, but they are designed on the same principles, and are better or worse modes of effecting the same objects.

The Dislocations of the Clavicle are two in number—namely, those of the acromial and sternal ends.

Dislocation of the sternal end occurs less frequently than that of the acromial end. It is caused by the patient falling on the point of the shoulder. The sternal end of the bone is thereby thrust forcibly forwards, so as to rupture the anterior part of the capsular ligament of the joint, and project upon the sternum, where it forms a large and very marked swelling. The symptoms of this dislocation are so marked that the diagnosis is easy.

The dislocation is reduced by drawing back the shoulders. The elbow is then brought to the side, and a broad figure-of-eight bandage, with a pad over the dislocated end of the clavicle, applied.

Dislocation of the sternal end may also take place backwards and upwards behind the sternum towards the neck, but this rarely happens. It then presses upon the œsophagus and the great vessels at the root of the neck, and may give rise to serious consequences. This condition may also arise in consequence of disease of the spine, and then it is a sort of secondary dislocation.

In such cases it has sometimes been found necessary to cut down upon the clavicle and remove the sternal end of the bone, so as to get rid of the pressure caused by it. This dislocation is exceedingly rare, and can hardly be regarded as a dislocation proper.

Dislocation of the acromial end of the clavicle is not very uncommon. There is comparatively a very small surface of the broad end of the clavicle articulated with the acromion, and if a person falls on the point of the shoulder the end of the clavicle may be projected from the acromion, and dislocated. The ligaments which keep it in position give way, and it remains merely attached to the coraco-clavicular ligaments, which as a rule do not yield. Hence the arm does not fall very much at first, though it may do so afterwards, and then the acromial end of the clavicle projects, giving rise to appearances somewhat like those seen in dislocation of the humerus. In a front view the two cases appear very much alike, as they both present a marked elevation at the point of the shoulder, and a depression underneath. In a side view, however, a marked difference will be observed, inasmuch as the end of the clavicle will in this injury alone be seen instead of the broad arch formed by the acromion and clavicle in dislocation of the shoulder. Moreover, the edge of the trapezius, tending to draw back the clavicle, is seen to stand out in bold relief. Without these precautions you may err in your diagnosis. All doubt will be dispelled when you begin to manipulate the parts.

This dislocation requires very careful treatment. Sir Astley Cooper affirmed that it never healed. He was of opinion that the articulating surfaces were so small, and the ligamentous textures united so imperfectly, that it was impossible to keep the parts in accurate contact. I have found in some cases that, though the dislocation was easily enough reduced at first, it never healed completely; in the majority of my cases, however, the dislocation has done well enough. The parts become firmly united, and no deformity is left, the arm remaining as useful as before. The result depends a good deal on the care taken by the patient himself. The *Treatment* of this dislocation is very much the same as that recommended in fracture of the clavicle, and almost the same apparatus is required. We must, however, not only brace back the shoulders, but we must have a pad pressing upon the acromial end of the clavicle, so as to keep it for at least six weeks in close apposition to the bone with which it is articulated, in order that the fibrous textures may unite thoroughly. Here is a cast taken from the shoulder of an old man, a patient of mine, who suffered from this injury, and who, from his age and habits (he was not an abstainer), gave little hope of recovery, yet with care and extra precautions he was entirely restored.

The Scapula may be broken almost at any point. It is generally

broken obliquely through its spine. The fractures of the body of the scapula are generally caused by great and direct violence, and are attended with much swelling and pain.

Deep-seated crepitus may be discovered on moving the arm, or by grasping the coracoid process with one hand, and moving the body of the scapula with the other. The *Treatment* consists in confining the movements of the bone by a bandage, placing a pad in the axilla, and keeping the arm close to the side. In fracture of the acromion there is generally drooping and rounding of the shoulder, with a want of power in raising the arm; it is generally merely the point of the acromion that is broken off. The treatment consists in placing a pad in the axilla, and keeping the arm fixed to the side—the same apparatus as is used in most fractures about the shoulder-joint.

There is a fracture of the scapula which occurs, though very rarely, and which is difficult to diagnose from dislocation at the shoulder. This is fracture of the neck of the scapula, or fracture through the glenoid cavity detaching almost all that part of the bone. This fracture was first described by Sir Astley Cooper. In it the shoulder presents a square appearance, and a cavity is seen below the acromial arch, just as in dislocation of the shoulder. The elbow projects from the side, and when we raise the arm and draw it out the dislocation disappears. The existence of this fracture is denied by some, and one of Sir A. Cooper's supposed cases was proved after death not to have been fracture of the scapula at all, but an oblique fracture through the head of the humerus. The fracture, however, really does occur, though it is very rare; for I had a case in hospital where the body was examined after death, and the scapula was found to be broken through the neck of the glenoid cavity (plate xv. fig. 1).*

The *Treatment* is the same as in fracture of the neck of the humerus or of the clavicle: place a pad in the axilla, and fix the scapula by a broad handkerchief or bandage, keeping the arm slung and the elbow bound to the side. The fracture unites readily enough, and leaves a useful arm.

* See Clinical Cases at end of section.

LECTURE XLVI.

Fracture of Neck of Humerus—Diastasis—Inter-articular Fracture in Adults—Displacing causes in Fracture of Surgical Neck—Diagnosis between these Injuries and Dislocations—Treatment—Dislocation of Humerus at Shoulder-joint—Diagnostic Symptoms—Treatment—Different modes of Reduction—Fracture of Surgical Neck of Humerus accompanying Dislocation—Mode in which the accident occurs—Treatment.

Fracture of the Neck of the Humerus.—This term is usually applied to fracture of the surgical neck of the humerus. Fracture through the anatomical neck is comparatively rare, and generally occurs in the form of diastasis in young subjects before the epiphyses are fairly connected with the shaft of the bone. An inter-articular fracture does, however, occasionally occur in adults.

In fracture of the surgical neck we have the humerus shortened, the elbow slightly tilted from the side, and a depression formed a little above the insertion of the deltoid muscle. The shoulder is rounded, and there is often some degree of swelling, which adds to this appearance (plate xvi. fig. 5). If we pass the hand from the acromion process downwards, we feel the head of the humerus in its place, and then lower down we feel the depression above the insertion of the deltoid. The head of the bone is kept very nearly in position by the capsular muscles. The shaft of the bone is very much displaced, its axis being altered by the tilting outwards of the lower portion. The upper part of the broken shaft is drawn in towards the axilla and chest by the action of the muscles attached to the bicipital groove—namely, the pectoralis major, the latissimus dorsi, and the teres major. The deltoid still further assists this displacement by drawing the shaft upwards (plate xvi. fig. 6). The fracture is therefore attended with shortening, great distortion, and loss of power in moving the arm. The surgeon can however move the limb, though this causes pain to the patient. When the arm is forcibly extended we feel crepitus. We may rotate the shaft of the humerus without producing any, but if we rotate the arm after extending it, so as to bring the broken surfaces of the bone in contact, crepitus is produced. Fracture of the surgical neck is almost always caused by direct violence, such as falls, or blows on the shoulder.

As we have already stated, fracture of the humerus between the tuberosities and the head of the bone, that is through the anatomical neck, occurs also, though not so frequently as the former fracture, and chiefly in young children, where the cartilaginous head of the bone is

but loosely connected with the tuberosities. An unusual force applied to the elbow or shoulder may produce it. There is much difficulty in diagnosing between this diastasis and dislocation. When the comparatively small portion forming the proper head of the bone is left in relation to the glenoid cavity, the arch of the acromion projects, the tuberosities fall into the axilla and are drawn towards the chest, the shoulder is square and not rounded, so that all the appearances of dislocation may be produced. Then the symptom of crepitus is wanting in this fracture on account of the semi-cartilaginous state of the bones in the young subject. Still we can, by a little extension, and by putting the arm in position, bring the tuberosities up into contact with the acromion process, and then the roundness of the shoulder is restored, and the axis of the shaft of the humerus is restored also. These results, however, are only temporary, for whenever we take away the support the bone falls out of position, showing that the case is not one of dislocation but of fracture or separation.

Fracture of the anatomical neck also occurs in adults, perhaps more frequently than is supposed, but generally it is partly extra-capsular as well as intra-capsular. One part of the fracture, therefore, corresponds to the anatomical neck, the other occurs obliquely through the tuberosities. This is almost invariably the case in adults.

The *Treatment* is very simple if we once recognise the lesion, and it ought to be easily recognised. The arm should be extended, and the ends of the bone brought into contact, and kept in that position. The elbow should be brought to the side, and a pad of wadding placed in the axilla. This acts as a fulcrum,—the humerus being the lever—and effectually prevents the broken end of the bone from being drawn in again towards the chest. The essential parts of the retentive apparatus, therefore, are a pad in the axilla, a sling for the arm, and a roller to secure the elbow to the side.

The position of the arm should be different from what it is when placed for the treatment of fracture of the clavicle, in which case the elbow is bent at an acute angle, and thrown across the chest obliquely, with the fingers resting on the opposite shoulder. In treating this fracture the arm should be kept parallel to the side, with the elbow bent at a right angle and supported by a sling. In fractures of the shaft of the humerus the sling is so placed on the forearm as to leave the elbow free. Thus the weight of the lower part of the limb is made to act as an extending power. Some surgeons hold that this should also be done in fracture of the surgical neck; but I do not consider it good treatment, for the ends of the bone are not likely to be kept in contact unless the elbow is supported. If this be done with the pad in the axilla, there is no fear of the parts overlapping each other; but if support be not given to the elbow there is a very great risk of imperfect union. In some cases splints are applied; now a splint is of no use as regards accuracy in the coaptation of the fracture, for the internal splint cannot be placed so high as the point where the bone is broken. We cannot get a splint so far up into the axilla, and the outer splint is of no use without the inner one. Splints should only be put on in children or very restless patients, where we

wish to prevent movement of the hand, wrist, and elbow, so as to obtain perfect rest for the broken bone. But for securing coaptation in this fracture splints are useless. The treatment of fracture of the anatomical neck of the humerus is exactly the same as that of fracture of the surgical neck; and this injury generally unites readily without deformity or loss of power in the arm.

Dislocations of the Shoulder may, for all practical purposes, be described as three in number:—

1. Dislocation downwards into the axilla.
2. Dislocation forwards.
3. Dislocation backwards.

The second of these is subdivided by many into two stages, sub-coracoid and sub-clavicular; but this subdivision is unnecessary. The third form is exceedingly rare; I have never seen a case of it.

Certain symptoms are common to them all. One of these is a peculiar well-marked flattening of the shoulder. In fracture of the neck of the scapula, and also in diastasis of the head of the humerus from the tuberosities and shaft, we meet with the same appearance, causing these injuries to resemble dislocation. In them the shoulder undergoes an equal alteration in its contour, and there is a similar cavity or depression formed under the acromion process. The squareness of the shoulder is caused by the head of the humerus being forced out of the glenoid cavity, and so leaving the arch of the acromion prominent.

In dislocation of the head of the humerus downwards into the axilla, the arch formed by the acromion process and the clavicle is left projecting, and there is a large cavity corresponding to the normal position of the head and tuberosities of the bone. This produces the squareness of the shoulder, together with lengthening of the limb, and slight tilting-out of the arm (plate xvi. figs. 3 and 4). There is considerable pain and swelling, owing to pressure by the head of the bone on the axillary plexus of nerves. In the natural position of parts, if we trace with the finger forwards and downwards from the acromion process, we come directly upon the tuberosities of the humerus; but in the dislocation we come at once upon a space from which the head of the bone has been removed. It may be observed here, however, that if we examine at the back of the arm, especially in a thin person, we can feel a depression even though there be no dislocation. In front the coracoid process can always be felt on the inner side of the head of the humerus in the normal position of parts, and if we feel this we may be sure that the head of the bone is in its right place. Thus the position of the acromion and coracoid processes of the scapula, with reference to the head of the humerus, forms the best diagnostic guide in assuring us of the presence or absence of a dislocation. If the head of the bone be felt away from the coracoid and acromion processes, resting on the neck of the scapula, and the axis of the humerus be slightly altered, being more oblique than it naturally is; and if the head of the bone can be made to move slightly, so that we can feel it in the axilla, though we cannot rotate it freely, we may conclude that we have to do with such a dislocation as we have described.

In dislocation of the head of the humerus forwards, the symptoms vary somewhat, according to the degree of the injury and the nature of the force which caused it. Dislocations forwards are almost all caused by the patient falling with the hand outstretched. This dislocation is generally sub-coracoid—that is, the head of the bone lies under and to the inner side of the coracoid process. Sometimes it may lie much more upwards and forwards, nearer to the clavicle. This injury is marked by shortening of the arm and greater abduction of the elbow. The head of the bone can be traced to the inner side of the coracoid process, and quite away from the acromion process and the glenoid cavity. It is attended with the same squareness of the shoulder as are the other dislocations, and the same, or even a greater alteration, in the direction of the limb. The latissimus dorsi and teres major muscles draw the bone in towards the chest, and the deltoid and pectoralis major draw the head and tuberosities upwards towards the clavicle, thus producing a considerable degree of shortening of the limb. In some cases there is great pain in the axilla from the increased pressure on the axillary nerves. This is not a constant symptom; the pain is often not so great as in the dislocation downwards, for the nerves sometimes seem to slip over the head of the bone and so escape the pressure. Sometimes in this dislocation there is considerable œdema and coldness of the limb, from the interrupted circulation, both venous and arterial. In dislocation downwards there is lengthening of the limb; whilst in this dislocation the limb is shortened and the elbow is more tilted out, and the axis of the shaft more oblique.

In dislocation of the head of the humerus backwards, the head of the bone rests on the dorsum of the scapula, the elbow is tilted forwards and outwards, and there is the same squareness of the shoulder as in the two former cases. This injury should be easily diagnosed, from the head of the bone forming a projection on the dorsum of the scapula, and there would be a marked alteration in the position of the arm.

We must now attend to the method of reduction in these dislocations. In dislocation of the head of the humerus we have a better chance of success, even some time after its occurrence, than we would have in treating a hinge-like joint for the same injury. Yet in all cases the sooner reduction can be effected the better. If the case be recent and uncomplicated, all that we require to do may be to fix the scapula with the knee in the axilla, and draw upon the arm, when the dislocation is reduced almost spontaneously.

The patient should be seated on a chair. The surgeon places himself beside him, separates the arm sufficiently to admit his knee into the axilla, then resting his foot on the chair, he grasps the arm just above the elbow with his right hand, and fixes the acromion with his left. He then draws down the arm over his knee, and reduces the dislocation.

As a general rule, the best method of reducing dislocations of the humerus is to place the patient in the recumbent posture, and bring him thoroughly under the influence of chloroform. The surgeon sits down beside and fronting the patient, separates the injured arm from

the side, to enable him to place his heel in the axilla, so as to fix the scapula, whilst the foot forms a fulcrum over which he extends the dislocated bone by grasping the arm above the elbow and pulling downwards, or downwards and outwards, as the case may require. In general the reduction is readily effected. The heel should be pressed outwards away from the chest and towards the arm, so as both to avoid injury to the ribs and act more efficiently as a fulcrum for the arm. The forearm should be bent to relax the long head of the biceps, and also to enable the surgeon to rotate the humerus at the same time that he extends. More extending power can be obtained, if necessary, by applying a worsted laque, or large handkerchief, in the form of the clove-hitch, above the elbow, and pulling by the ends of the laque so formed (plate xix. fig. 5).

In cases where we use pulleys a wetted bandage is placed round the limb before applying the laque, to obviate the risk of the laque slipping, and prevent excoriation of the skin.

In these methods the knee in the one case, or the heel in the other, serves as a fulcrum over which the shaft of the humerus is used as a lever to raise its dislocated head from its abnormal position.

A third method of reduction, sometimes used, is as follows: The surgeon standing, or sitting on a chair, behind the recumbent patient, desires an assistant to fix the patient's body. He next places the sole of his foot against the upper surface of the acromion, so as to fix the scapula; then, seizing the dislocated arm by the hand and wrist, he draws it outwards, upwards, and backwards, until it is brought up almost parallel to the patient's head and neck, and, by continuing extension, the head of the humerus may slip into the glenoid cavity.

Sometimes pulleys are used for purposes of extension, while the trunk and scapula are fixed by laque to a ringbolt or some fixed point. An assistant at the same time draws the arm outwards at the dislocated part by means of a towel placed around it. This is simply a modification of the modes already described, by which a greater degree of force, gradually and evenly applied, is brought to bear on the operation.

Various other methods have been advocated, and are employed, with greater or less advantage, according to circumstances; but they are all founded on the same obvious principles, and whichever you adopt, bear in mind that the extending force must be applied gradually, and the manipulations performed with care.

When the head of the bone has been restored to the glenoid cavity, we place a pad in the axilla, and the arm is kept fixed to the side by a sling. If the head of the bone happens to have escaped through a small opening in the ligaments, the reduction will be much more difficult than if the opening be large; and if the ligamentous textures be tense, the difficulty will be still greater. When we once begin to attempt reduction in long-standing dislocations, we do not like to give up without effecting it, but we should remember that our efforts to do this may cause greater damage than the unreduced dislocation would. If we find, after a fair trial by pulleys and other means, that we cannot reduce the dislocation, then we should stop, especially in old people,

whose arteries are liable to give way. Such an event as this would complicate the injury very much.

Another condition must be remembered in these dislocations—namely, that we may have a fracture of the surgical neck of the humerus accompanying the dislocation, though at one time this was doubted. When this accident happens the dislocation occurs first, and afterwards the dislocated shaft of the bone is broken. I do not believe that if the fracture should take place first any amount of force could dislocate the head of the bone. The dislocation always takes place first, and then the bone is easily enough fractured. This injury is easy to make out when present, but the reduction is exceedingly difficult, for we have no power to act on the head of the bone, and, in fact, we depend more upon chance than upon anything else. If the head of the bone have escaped through a small opening in the ligamentous textures, it is hopeless to try and effect reduction, but we have a much better chance if the opening be large. In such cases the limb must be kept in the retentive apparatus for five or six weeks, and must be treated just like a fracture of the neck of the humerus, though the after-treatment requires more care than usual.*

* See Clinical Cases at end of section.

LECTURE XLVII.

Fracture of the Shaft of the Humerus—Diagnostic appearances and symptoms—Above insertion of Deltoid—Transverse and Oblique Fractures—Mode of Treatment—Fractures of Humerus near Elbow-joint—Difficulties of Diagnosis—Method of Examining, and Treatment—Dislocation of Elbow—Of both Bones—Of Ulna—of Radius—Method of Reduction—After-treatment.

Fractures of the Shaft of the Humerus are of very common occurrence, and, as a rule, very easy of diagnosis. They are generally accompanied by a marked shortening and distortion of the limb, and, in most cases, crepitus can be readily elicited. When the fracture occurs between the insertions of the pectoralis major and latissimus dorsi above, and the deltoid below, the displacement is almost always in one direction. The two former muscles draw the upper portion of the bone towards the chest; whilst the latter, acting on the lower portion, draws it upwards and partly outwards, so that it lies to the outer side of the upper part of the bone (plate xvi. fig. 8). In such a case no special treatment is required; all that is necessary, after adjusting the fracture, is to apply well-padded splints on the outer and inner sides of the arm (plate xvi. fig. 11). The arm should be flexed at right angles, but the elbow unsupported by the sling, so that the upper arm may be allowed to hang straight down (plate xvi. fig. 7). If this treatment be maintained there will be no great danger of displacement recurring. When the fracture happens near the middle of the humerus, the displacement differs in different cases, being generally regulated by the direction of the obliquity, so that if the fracture be transverse there is often little or no displacement. In an oblique fracture the fragments glide in one or other direction, according to the direction of the oblique surfaces, so that the muscles by their contraction simply produce shortening of the limb, while the over-lapping of the tapered ends of the broken bone produces the distortion. In such cases, by extension and counter-extension, coaptation can be readily effected.

In treating fractures of the shaft of the humerus the elbow should be unsupported, so that the weight of the lower part of the arm may act as an extending power. On the other hand, in fracture of the surgical neck of the humerus, the elbow should be supported; if it be not, the weight of the upper arm may drag away the large lower portion of the humerus from the small upper fragment, as stated when speaking of the treatment of that fracture.

In fractures of the humerus lower down, in the neighbourhood of the elbow-joint, most careful attention is required in forming a diagnosis, more especially if the patient be young. In children there

is a very great tendency to the occurrence of dislocation at that part, and in them we also meet with separation or diastasis of the articular ends of the bone from the shaft, and these two accidents bear a close resemblance to each other. In this region we meet with splitting of the condyles, sometimes in one direction, sometimes in another. These injuries are attended with immediate swelling; a great deal of effusion takes place into the joint at an early period, and renders the difficulty of diagnosis very great, unless the parts be examined immediately after the accident. We require to be very careful in our examination of such cases, for on making an accurate diagnosis everything depends.

If we have to do with a dislocation we can easily reduce it at once; but if we fail to do so, thinking the injury is a fracture, the consequences may be very serious. If we find the arm of a child shortened and swollen before and behind, and if we find that we can neither flex nor extend the elbow, the probability is that we have to deal with a dislocation. In most cases we have a guide which should prevent us from mistaking a dislocation for anything else, even when there is much swelling. In the natural state of parts, when the arm is semi-flexed, the point of the olecranon is much below the level of the internal condyle of the humerus. Now, by feeling along the back of the bone, and pressing inwards when there is swelling, we discover the inner condyle projecting from the condyloid portion of the shaft. We then trace backwards to the olecranon, and if we find that the point of it is lying at a lower level than the internal condyle, we may conclude that the injury is not a dislocation of the ulna. Or we may examine to ascertain if the condyles and articular surface of the humerus be thrust in front of the bones of the forearm, as the hard rounded projection so caused is in general very perceptible.

If we should find that there is so much swelling behind and in front that we cannot trace these relations, we next extend the arm, as in treating a dislocation, and try to reduce the parts. If the injury happens to be a diastasis of the articular ends of the bone we shall be able in this way to bring the parts into their natural position. As soon, however, as we leave off the extension and counter-extension, the deformity will return, thus showing that the injury is a separation of the epiphyses from the condyloid portion of the shaft. This can be done even when there is much swelling present, if we put the patient under chloroform—as we ought always to do. In manipulating, we should first extend the limb fully, and then bend the forearm upon the upper arm. If this can be done to such an extent that the hand can be forced backwards so as to touch the point of the shoulder, and if we can again extend the forearm freely upon the upper arm without any shortening, then we may safely conclude that if the injury was a dislocation, we have succeeded in reducing it; whereas, in the case of a fracture, we should by the same means elicit crepitus very distinctly.

In cases of oblique fracture through the condyles, we sometimes cannot make out the crepitus readily if we lay hold of both condyles with one hand, for in that case we would be holding the broken parts together. We should therefore handle them separately. Fracture of the outer condyle, or lesser head of the humerus, resembles dislocation

of the head of the radius backwards, that bone being carried back along with the broken fragment. But the crepitus, and the ease with which the parts are brought into position show us what the injury really is.

One mode of treatment is suitable to all these fractures about the condyles. This consists in placing a pad of wadding in the bend of the elbow, retained in position by a figure-of-eight bandage round the joint; and this is all that is required. The arm should be kept at a pretty acute angle, to prevent separation of the fragments, and to prevent the muscles which arise from the condyles of the humerus from drawing the broken condyle downwards (plate xvi. fig. 10).

Dislocation of the Elbow may occur in different ways—generally from the patient falling with the hand extended or the arm semiflexed.

The most common dislocation is that of both bones backwards. In this condition the arm is semiflexed, or rather less, there is a projection backwards and a swelling in front. The forearm is shortened and altered in form, becoming more rounded than usual. This dislocation is easily discovered on careful examination, though it is not so obvious as might be supposed from seeing it merely on the skeleton. The best diagnostic is the projection of the condyles in front, forming a swelling there, and the altered relation of the inner condyle to the olecranon, which now lies above instead of below it. We take the relations of the olecranon and inner condyle as our guide, and tracing down the shaft of the humerus in front, we suddenly come upon a swelling at the elbow, and then we find the radius and ulna situated much more deeply than their usual place. In position, the arm is nearly semiflexed; and, though we cannot fully flex it, we can often bring it to a right angle. Neither can we extend the arm fully.

Having made out this dislocation, the mode of reduction is next to be attended to. We are told that the best method is to bend the bones of the forearm over our elbow or knee, placed in the bend of the patient's elbow. This will not always enable us to effect reduction. If, however, we first extend the hand and forearm backwards, we shall then have merely the point of the coronoid process touching the humerus, and there will then be very little opposition to reduction. The best plan therefore is to extend the hand and forearm backwards, and when the parts yield a little, then flex. In children this dislocation is generally very easily reduced.

In dislocation of both bones, backwards and laterally, either to the outer or inner side, the displacement is much more marked than in the former case, but the symptoms are much the same. There is the shortening of the limb, and the projection before and behind the elbow, as already described.

In some cases we have the ulna alone dislocated, the radius remaining *in situ*. The injury is readily enough ascertained from the ulna projecting very far back, and the olecranon lying higher up than usual. The mode of reduction is the same as in dislocation of both bones backwards, and by pressing on the bone laterally, at the same time that we extend we facilitate the reduction. So also in the two former dis-

locations, besides using extension and flexion, we may apply direct pressure on the ends of the bones, so as to assist the extending power.

The radius may be dislocated by itself, either backwards or forwards. In fracture of the outer condyle of the humerus we have appearances very like those exhibited in the former of these. In the dislocation backwards the annular ligament is torn, and occasionally the external lateral ligament, and the head of the bone plays on the back of the outer condyle. In dislocation forwards, on attempting to flex the arm we feel a sudden check; the roundness of the forearm is very marked.

The mode of reduction is slightly different in the two dislocations. In the dislocation forwards the forearm should be drawn downwards and outwards, and the hand supinated as far as possible, so as to rotate the head of the radius outwards from its abnormal position. By acting through the medium of the hand we obtain power over the radius. In the dislocation backwards we extend the arm and then attempt to pronate the hand and flex the forearm. So far as the mere reduction goes, it is easy enough if the case be seen early. In dislocation of the head of the radius backwards or forwards the head of the bone has a great tendency to slip out again after it has been reduced. It is articulated in such a way, that before dislocation can take place the annular ligament must be torn, and the lateral ligaments also partially or entirely separated. These ligaments take a long time to unite; and if the patient begins to move the arm too soon, the head of the bone is almost sure to slip out. Hence, after this dislocation, the arm must be bandaged as it is in cases of fractures of the condyles, and kept quiet for a longer period than is generally necessary in other dislocations.

LECTURE XLVIII.

Fractures of Bones of Forearm—Of the Olecranon—Method of Treatment—Of Coronoid Process—Fracture of Shaft of Ulna—Fracture of both Bones of the Forearm—Near Wrist-Joint, simulating Dislocation backwards—Method of Treatment—Fracture of the Radius above Bicipital Tubercle—Above insertion of Pronator Quadratus—Above Styloid Process—Displacing Causes and method of Treatment—Dislocation of the Wrist—Method of diagnosis and Reduction—Fractures and Dislocations of the Metacarpal Bones and Phalanges—Dislocation of Thumb—Fracture of Metacarpal Bones—Compound Fracture of Fingers.

We shall now consider the fractures occurring in the bones of the forearm, and first those of the ulna.

Fracture of the Olecranon Process of the ulna is generally the result of direct violence, the bone snapping across just at the middle, or nearer the point of that process. The resulting displacement is very marked. The portion broken off from the shaft of the ulna is dragged upwards by the action of the triceps muscle, leaving a distinct interval between the broken surfaces. If the arm be kept nearly straight, the interval is less visible; but if it be flexed the gap becomes widened, and leaves a well-marked space between the broken ends of the bone. The amount of separation will depend on the extent to which the internal lateral ligament of the elbow-joint is detached from the bone. Some of its fibres are attached near to the point of the olecranon, and if these fibres are not torn through, the inner side of the upper fragment will be kept pretty nearly in contact with the shaft of the ulna, and will not be dragged upwards by the triceps. This portion of the internal lateral ligament used to be called the ligament of Sir Astley Cooper, who described it in his work on fractures. If the ligament be completely torn through, the displacement will be much greater, for in that case there is nothing left to resist the action of the triceps. In most cases the fracture is readily enough detected—even when the displacement is not very great—from the mobility of the small upper fragment. In some cases the bone may be split obliquely or almost longitudinally, so that we have the two fragments of the olecranon attached to the tendon of the triceps, and therefore not separated by it.

In transverse fracture of the olecranon we meet with the greatest amount of separation. When the fracture is detected in time there is no difficulty in effecting coaptation. To do this the limb has to be straightened, in order to bring the ulna as far back as possible, also to relax the triceps, and so approximate the upper fragment to the shaft. The two separated portions are thus brought into as close contact as

possible, and in order to keep them so, we place the arm extended, and apply a splint in front, sufficiently long to reach from the middle of the upper arm to the middle of the forearm. Sometimes a longer splint is required when we wish to fix the hand and wrist. The splint is secured by a roller and the usual figure-of-eight bandage round the elbow (plate xvi. fig. 12).*

We are sometimes advised to put on the figure-of-eight bandage first, and then apply the splint and secure it, so as to have the ends of the bone dragged together accurately by it. If we attempt to do too much at first we are not likely to succeed so well as if we proceed more gradually. The fracture is attended with much effusion and swelling into the joint. The upper fragment floats, as it were, on the fluid, and so long as the effusion is there we cannot expect absolutely perfect coaptation, and therefore we should not try, by the figure-of-eight bandage, to force the parts into contact. We should apply the retentive apparatus lightly at first, allow the swelling to subside, which it soon does, and then re-apply the bandage and splint more firmly, so as to keep the limb perfectly straight, and prevent all flexion.

Sometimes we have to deal with a fracture of the lower part of the humerus along with a fracture of the olecranon. This happens occasionally, though not often. In such cases we must make a sort of compromise in our treatment. The best method of dealing with the humeral fracture would be to keep the arm at a right angle. This would cause a wide separation of the broken portions of the ulna, and we are therefore obliged, in order to meet both conditions, to keep the arm bent at an obtuse angle. Under any circumstances this is a difficult accident to treat properly.

In fracture of the olecranon we find that the union is generally by ligamentous texture and not by bone. This does not affect the usefulness of the limb afterwards, if the bone be well set, for then the ligamentous texture is short and firm, and, indeed, the great object is to have the uniting medium as short as possible. The same thing occurs in fracture of the patella.

Fracture of the Coronoid Process of the ulna sometimes happens, in which that portion of the process giving attachment to the brachialis anticus is separated from the ulna. The brachialis anticus retracts to a certain extent, and the small fragment is drawn upwards by it in front of the arm, and so forms an obstacle to flexion of the limb. The joint also projects backwards in flexion, for want of the check afforded by the process and its attachments to prevent the ulna from going back, and this may give the appearance of dislocation of the ulna alone without the radius. On attempting flexion, we find that we cannot easily accomplish it, in consequence of the position of the upper fragment. On bringing the bone into position again, we can produce crepitus, showing that it is a case of fracture. This injury is very rare, and it is very obscure when it does occur. Some surgical authors state

* In the plate, the arm is represented so as to exhibit the position of the splint and figure-of-eight bandage only, but in this fracture, the hand and forearm should be bandaged from the fingers upwards before the splint is applied.

that dislocation of the ulna backwards cannot take place without fracture of the coronoid process; but I have never seen a case of that dislocation in which the coronoid process was broken.

The way to treat fracture of the coronoid process is to flex the limb, and place a pad of wadding in the bend of the elbow, supported by a figure-of-eight bandage (plate xvi. fig. 10).

Fracture of the Shaft of the Ulna may occur at any point. It generally happens low down, but sometimes, from direct violence it may be broken high up. If the fracture take place along with a corresponding fracture of the radius, the treatment is not difficult. If the ulna alone gives way above, or at its middle part, without fracture of the radius, there is sometimes great difficulty experienced in treating it, for in that case we have no power to act directly on the bone so as to bring the displaced fragments into position. The muscles acting on it draw the different portions of the bone inwards, thus narrowing the interosseous space and curving the bone on itself. In a similar fracture of the radius, without a corresponding fracture of the ulna, we can act on the broken bone by extension through the medium of the hand; but in connection with the ulna we have no such power, and sometimes in a muscular limb there is very great difficulty in bringing the fracture into accurate position. The displacing causes in fracture of the shaft of the ulna are the various muscles of the forearm. The pronators and supinators draw the bone inwards and twist it, while the flexors and extensors shorten it. When the fracture is lower down the displacement is not so great, and there is not so much difficulty in the treatment. The other conditions are the same.

In fracture of both radius and ulna together, the displacement and the difficulty of treatment are less. Here we have a command over the broken bones through the hand and forearm, and we can thus bring the fragments into accurate apposition. We require to be very careful in the after-treatment of these cases, for the muscles of the forearm have a constant tendency to draw the bones inwards towards the interosseous space, and if union take place in that position, the motions of pronation and supination will be prevented. Splints, therefore must be carefully applied. They should be broader than the arm, that the bandage may not act on the sides of the bones, and so force them in towards each other, and a pad must be placed in front over the interosseous space. This tends to force down the muscles into the interosseous space, and helps to prevent displacement of the bones in that direction. The forearm should be placed between pronation and supination, and the elbow kept at a right angle. The posterior splint should reach from beyond the elbow to the point of the fingers, and another shorter splint is placed in front of the limb (plate xvi. fig. 13).

The nearer the fracture is to the wrist-joint, the greater is the deformity which results. In fracture of both radius and ulna close to the wrist-joint, we have an injury resembling dislocation of the hand backwards. There is swelling both on the back and in front of the wrist. The forearm is shortened, and the hand, together with the lower fragments of the radius and ulna, lies on a plane very far behind the general line of the forearm. In this case there can be little diffi-

culty in the diagnosis, because by slight extension and counter-extension we reduce it, and cause distinct crepitus. The treatment also is very simple. Well-padded splints are applied in front and behind. The forearm and the elbow are kept slung at a right angle.

Fractures of the Radius alone are much more common than those of the ulna. The highest fracture of the radius is that which occurs a little below the insertion of the biceps. In this position the small upper fragment becomes flexed upon the arm, and somewhat supinated by the action of the biceps, so that it projects, and can be sometimes readily felt. In most cases, however, there is very little displacement, and the difficulty often is to make out the fracture. The patient complains of pain on attempting to flex or move the arm. When we put the arm straight, we can feel the line of the radius apparently entire. The best way of ascertaining the presence of such a fracture is by rotating the forearm, and at the same time making examination with your hand placed on the back part of the elbow, where the head of the radius is very slightly covered. On the outside there are muscles covering it, but there are none posteriorly, and in that part we can feel the movements of the head of the bone in pronation and supination very readily. If we find on rotating the radius that the head of the bone moves along with the hand, then there is no fracture. We may have it move for a time very nearly synchronously with the hand, in consequence of the two fragments lying in close apposition, still it is not the same smooth movement that there is if the bone be entire. Again, by fixing the shaft of the radius and ulna, and moving the upper part of the radius, we can make one fragment touch the other, and then crepitus is felt.

The treatment of this fracture consists in placing the forearm in splints, which should be somewhat narrower than those used for fracture of the ulna, and keeping the arm bent at a right angle.

There are two special fractures of the radius lower down—above and below the pronator quadratus. The more common of these is that which takes place immediately above the styloid process.

In the higher fracture the hand falls in and is pronated. There is a swelling in front and behind. The pronator quadratus and the pronator teres, together with the extensors and the supinator longus, are here the chief displacing causes. The supinator longus tilts up the styloid end of the radius. The pronator teres cannot draw forwards and inwards the upper fragment readily, because it is counteracted by the supinator brevis, and this fragment lies therefore nearly in position. The biceps also tends to prevent this portion of the bone from being rotated inwards, so that in this fracture we have, as a general rule, the lower fragment lying in front of the upper, being rotated towards the ulna, by the almost unopposed action of the pronator quadratus.

In the lower fracture we meet with the very opposite condition. In it the lower fragment invariably lies behind. The displacing causes are more numerous than in the former case. We have the pronator quadratus, or at least the greater portion of it, above the site of the fracture; the few fibres which are connected to the lower fragment are so injured that they do not act. In this fracture the muscle rotates

inwards and pronates the upper portion of the radius, whilst the supinator radii longus tilts up the lower fragment, and the long extensors of the thumb and index finger draw back the hand along with the lower fragment, and so drag it obliquely upwards behind the shaft of the bone. It cannot pass in front, because the shaft has been rotated in front by the pronator quadratus. The general shortening is caused, as before, by the action of both flexors and extensors. The displacement is very marked in this fracture. The styloid process of the ulna naturally lies on a line with the posterior aspect of the hand, but in this fracture it seems to project in front. The hand is drawn backwards and outwards, and from the lower fragment lying behind we have the appearance of dislocation of the hand backwards and outwards. This displacement is caused by the hand, which is connected to the styloid process of the radius, being drawn back along with it. The ulna is really lying in its natural position; it is the hand that is drawn away from it. This fracture is very common, but it is one requiring a great deal of care and attention in the treatment. The injury to the muscles and tendons and their sheaths causes great stiffness afterwards, and it is sometimes weeks, or even months, before the patient gets the use of the hand again, from the effusion into the sheath of the tendons, and the consequent stiffness. The fracture is apt to be attended with great displacement, and the bones must therefore be placed and kept in accurate position, the tendency of the small styloid fragment being to be drawn backwards.

There are several different methods of treating this fracture. Sir Astley Cooper recommended placing the forearm and hand between two long, straight, and rather narrow splints, and then allowing the weight of the unsupported hand to counteract the tendency of the bone to be displaced upwards. The principle of this is good, but it is not a certain method of bringing about a cure. In some cases we can treat this fracture perfectly well by bandaging very carefully so as to keep the hand in this position. The patient, however, instinctively supports the dependent hand, and so is sure to move it, and therefore slightly curved or angular splints are frequently used to keep the hand in position—the slope beginning just at the wrist-joint (plate xvi. fig. 14). The splints should reach to the tips of the fingers, and should be less padded in front of the radius than on its posterior aspect. In applying these angular splints, they should be softened in warm water and moulded on the limb in such a manner as to curve the wrist and hand forwards, for if a pasteboard splint be applied flat in front, it has the same disadvantage as the wooden "pistol splint," that, whilst it may prevent tilting up of the hand, it tends to press the hand back, and so favours the tendency to displacement of the lower fragment of the radius. The limb is then carefully bandaged and kept thus for about three weeks, when the splints should be taken off and shortened, and the passive movements of the finger-joints should be begun. These passive movements do not affect the fractured portions of bone. After about four or five weeks we may begin slight passive movements of the wrist-joint, taking care while doing so to hold the arm firmly at the fractured point. If we keep the arm up in splints for six weeks or

more, till the bone is thoroughly united, the fingers and wrist become so stiff that the patient may not be able to use them for a long time.

Lately I have adopted another plan of treatment. Two splints are employed—an anterior Gooch and a posterior angular splint. The anterior splint should reach from the elbow joint to the wrist-joint and should correspond in breadth to the breadth of the forearm. Its upper extremity should be slightly cut away, so as to present a concavity to the elbow joint, whilst the lower extremity has its outer or radial angle removed for about an inch, so as to form a notch or deficiency of splint over the part of the forearm corresponding to the right position of the lower fragment. In this way the splint acts upon the upper fragment, repressing it into its place, but has no action upon the lower fragment. The posterior angular splint should consist of

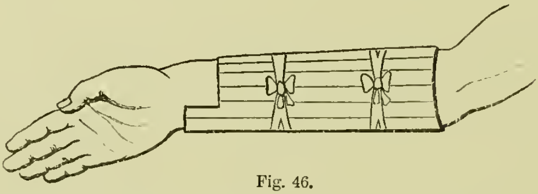


Fig. 46.

pasteboard, and extend from the elbow-joint to a point a little beyond the distal extremities of the metacarpal bones. The slope or angle should correspond to the wrist-joint—the convexity looking towards the radial side. The splint should be softened in water and moulded on the limb. By means of this splint the lower fragment is kept well forward in its place, and its action is not counteracted by the anterior splint, as it is notched away at this point. It is well to place a pad between the posterior splint and the lower fragment, and another elongated pad between the anterior splint and the shaft of the bone. The after treatment as regards passive movement and removal of the splints is the same as in the other methods.

Dislocation of the Wrist.—I have seen but one dislocation at the wrist-joint, and that was one of old standing. I used to be very doubtful as to the existence of such a dislocation, for most of the cases reported to me as such I have found to be cases of fracture. The one alluded to was really one of dislocation. In our diagnosis between dislocation, and fracture immediately above the styloid process of the radius, if we take as our guide the base of the metacarpal bone of the thumb and the styloid process of the radius, we find that in the fracture the distance between these two points does not vary—they remain in their natural relative positions. The hand and the lower fragment of the bone have been both drawn upwards and backwards, but there is no displacement of the carpus upon the radius. In the dislocation, however, this is very marked. The metacarpal bone is much higher up, and the styloid process is felt to approach the metacarpal bone in front,

Fig. 46. Method of treating fracture of Radius below the Pronatus Quadratus Muscle. Instead of the slip-knots represented, a roller is employed to retain the splints in position

causing swelling in that position. There is also a swelling behind, from the rounded mass of the carpus projecting posteriorly. In the radial fracture we have no alteration in the relative position of the metacarpal bone of the thumb and the styloid process of the radius, and we have not the swelling in front caused by the projection of the large articular end of the bone, so that we can scarcely mistake one injury for the other. Moreover, in the dislocation, once reduction has been effected, the displacement does not recur; whilst in the fracture, as soon as the extension and counter-extension are left off, the parts again become displaced.

The reduction of this dislocation will be easily accomplished by extension and counter-extension, drawing forward or backward the hand, according as the dislocation is behind or in front of the bones of the forearm. All the after-treatment required is to keep the parts in position for a few days with a bandage.

FRACTURES AND DISLOCATIONS OF THE METACARPAL BONES AND PHALANGES have next to come under our notice.

DISLOCATIONS OF THE THUMB are not uncommon, and their reduction is sometimes difficult on account of the small size of the portions of bone on which we have to make extension. In dislocation between the proximal phalanx and the metacarpal bone of the thumb, the head of the bone is generally thrust back and the lateral ligaments of the joint remain still entire or twisted, and in that position they constrict the head of the bone. This dislocation is the most common one in my experience. The under surface of the proximal end of the phalanx lies fixed on the posterior aspect of the metacarpal bone, where it causes a projection so evident that there can be no difficulty in diagnosing the injury. I have generally found little difficulty in reducing the dislocation; but still I know that such a difficulty has been met with, and it may occur in any case where the ligaments are only partially torn, and where the head of the bone has been thrust back forcibly between them, and fixed and constricted by their agency. In one of Mr. Liston's cases he was compelled to divide the lateral ligaments before he could reduce the dislocation; but in most cases we can do so by drawing upon the end of the bone, depressing the point of the thumb forcibly, and drawing it downwards and forwards. By putting the patient under chloroform we are able to get rid of all muscular opposition. Once the dislocation is reduced, all the treatment required is to apply a bandage round the thumb, and keep the hand quiet for a few days. The same treatment is applicable to dislocations of the fingers.

FRACTURES OF THE METACARPAL BONES are generally easily detected, though in some cases they are rather obscure, especially if only one bone has been broken, and more particularly if that be the metacarpal bone of the ring or middle finger. In such a case we have crepitus only when we press on the particular bone which is broken, because the other metacarpal bones act as lateral supports and keep it in position. Fracture of the metacarpal bone of the little finger is very easily made out.

The best way of putting up these fractures is to make the patient grasp a ball of soft worsted or tow in his hand, and then bandage up the hand in that position. The neighbouring bones act the part of splints. In certain cases we require to keep the hand straight, and then we apply a splint in front along with a bandage. In two or three weeks the fracture is completely united and no deformity results.

Compound fractures of the fingers generally require amputation on account of the accompanying laceration of the joints, tendons, and soft tissues.

Fractures and other injuries of the bones of the cranium and face, and those of the spine and trunk, I shall reserve for consideration under the head of Regional Surgery, as the complications arising from the implication of important organs are in these injuries the features of greatest interest.

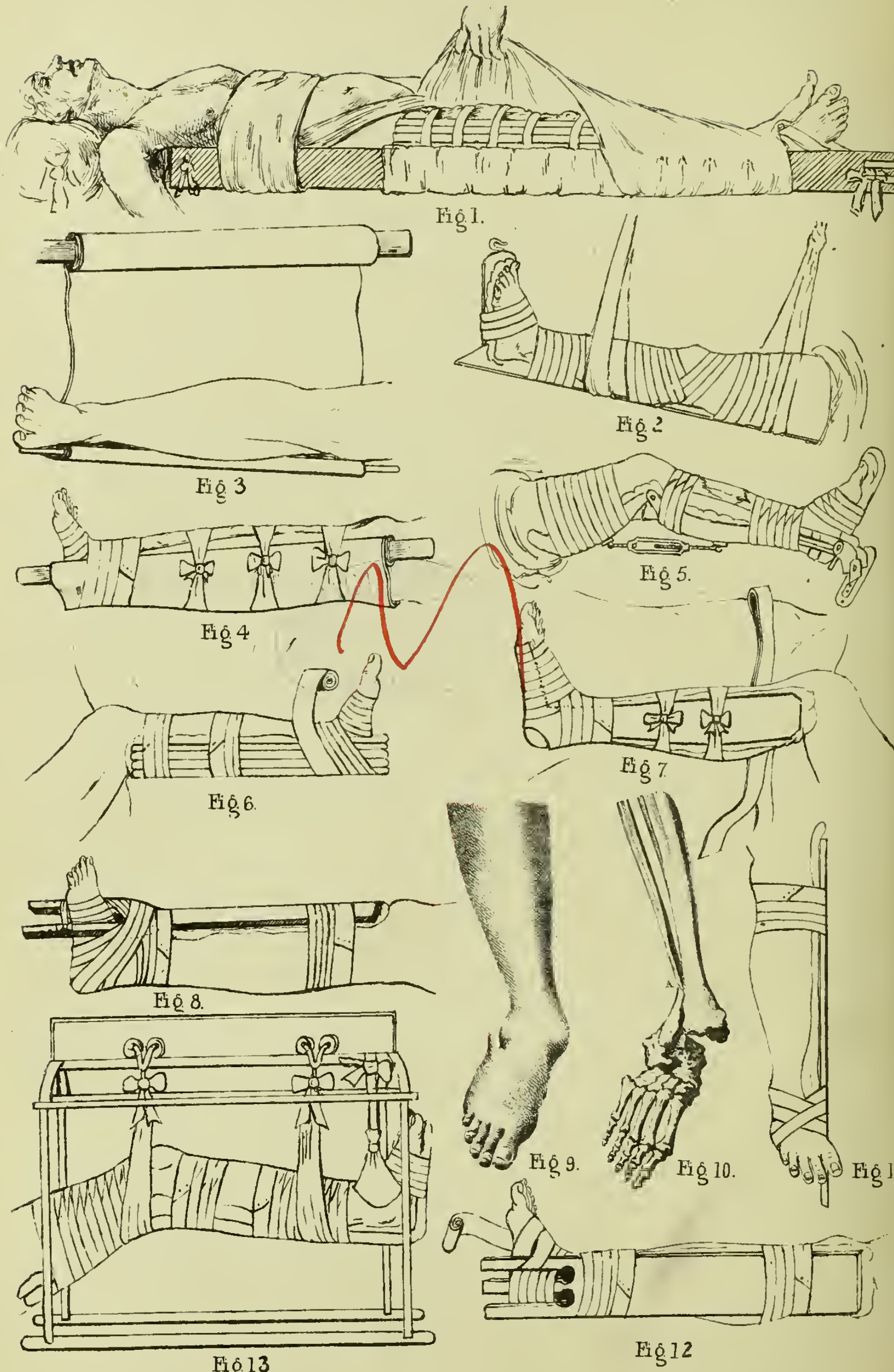


Fig 1.
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LECTURE XLIX.

Fractures and Dislocations of the Lower Extremity—Dislocation of the Hip-Joint—On the Dorsum Ilii—Into the Sciatic Notch—Into the Obturator Foramen—On the Pubis—Diagnostic Symptoms and Methods of Treatment.

We shall now proceed to discuss the fractures and dislocations of the lower extremity, commencing in this instance with the dislocations :—

The Dislocations of the Hip-Joint are four in number—two backwards, one downwards, and one forwards and slightly upwards. The two first are dislocation upwards and backwards on the dorsum of the ilium, and backwards and slightly upwards into the greater ischiatic notch. We shall consider these in the order of their frequency.

In dislocation of the head of the femur on the dorsum of the ilium, the knee and foot are turned inwards, the trochanter is felt further back and higher up than usual, and the head of the femur lies on the dorsum of the ilium. This is the most common of all the dislocations of the hip. There is shortening of the injured limb to the extent of one or two inches at least. The knee is inverted, the foot rests on the upper part of the tarsus of the opposite foot, and there is a great bulging at the hip from the projection of the trochanter (plate xviii. fig. 1). There should be little difficulty in diagnosing this dislocation, as there is only one fracture for which it can be mistaken, and that is more likely to be confounded with a dislocation of the head of the femur into the ischiatic notch.

Dislocation of the head of the femur into the greater ischiatic notch is somewhat rare. It sometimes occurs as a secondary dislocation when we are reducing the one already spoken of, or the dislocation downwards into the obturator foramen, but it also occurs as a primary injury.

The symptoms of dislocation into the ischiatic notch are somewhat similar to those attending dislocation on the dorsum ilii. The head of the femur tends to fall into the ischiatic notch, but is prevented from entering by the muscles which fill it up. It catches upon the edge of the ischiatic ligament and other textures, and pushes the softer tissues before it. There is a projection posteriorly, though to a less extent than in the former injury, and lower down. The limb is slightly bent, and inverted towards the opposite one, but does not tend to cross over it, as it does in luxation on the dorsum ilii. It is shortened, but much less so than in the former case, and the foot rests on the metatarsal bone of the great toe of the opposite foot. The knee is inverted, and touches the inner side of the opposite knee (plate xviii. fig. 2). Thus,

there is much less deformity, and the symptoms are less marked than in dislocation on the dorsum of the ilium, and more care is therefore required in the diagnosis.

In these dislocations we have one diagnostic mark—namely, the immobility of the limb as regards the natural movements. The limb is fixed at an angle, and we cannot move the femur from the os innominatum; both bones move together. Hence, in these two dislocations, if we lay the patient flat in bed we find that when his back is perfectly straight the limb is raised up and turned inwards. If we bring the limb down, as we can do with force, we make the back arch, and if we lay the back flat, the limb rises again. In the dislocation on the dorsum of the ilium this is one of the best diagnostics we can have. It is due to the angle at which the bone is fixed. Some speak as if this symptom were only referable to the dislocation into the ischiatic notch, but it is really less marked in that than in the other luxation. It is, however, more generally spoken of in reference to the dislocation into the ischiatic notch, for that injury is much more difficult to diagnose than the other, and therefore this diagnostic symptom is of more value. In both these injuries, therefore, we have somewhat the same symptoms—obliquity and shortening of the limb, with inversion of the knee. In the dislocation on the dorsum of the ilium, the deformity is greater and the swelling of the trochanter is much more visible. In dislocation into the ischiatic notch the symptoms are less marked, and the diagnosis, as well as the treatment, is more difficult.

In dislocation backwards the injury is caused by great force. No fall directly upon the trochanter would be likely to give rise to a dislocation. It occurs either by the patient coming to the ground with the knee bent while the body is still in motion, or more frequently from falls of earth, or the like, upon the back of the patient whilst he is stooping. It always requires a very considerable amount of indirect violence, with a certain position of the body and limb at the time, to cause these dislocations, for it requires great force to rupture the strong ligaments of the hip-joint. They are not uncommon accidents, though by no means so common as fractures in this region, which may be caused by a much less degree of force. The dislocation may sometimes be accompanied by fracture of the pelvis, from the kind of force causing the injury, as, for example, in pit accidents, or by a person falling from a great height; and then the prognosis is very unfavourable from the injury to the pelvic viscera, which is almost always present.

In the reduction of these dislocations the direction of the force should always be in the direction of the axis of the dislocated bone, the pelvis and trunk being fixed. As a general rule, the laque should be fixed above the knee-joint, so as to act on the femur directly, though I have often succeeded in reducing a dislocation by fixing the laque above the ankle when I have failed with it placed above the knee. Still, as a general rule, we should begin with the laque fixed in that position. In reducing luxation on the dorsum ilii, the force should be directed in such a way as to carry the bone obliquely downwards and forwards. A sheet is placed round the limb, and an assistant draws

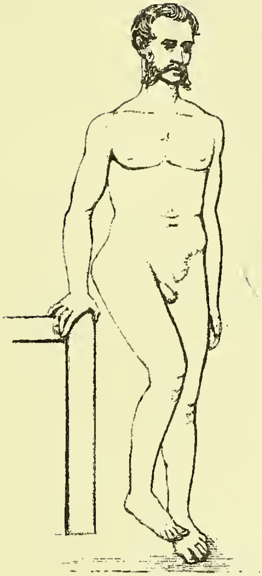


Fig 1.

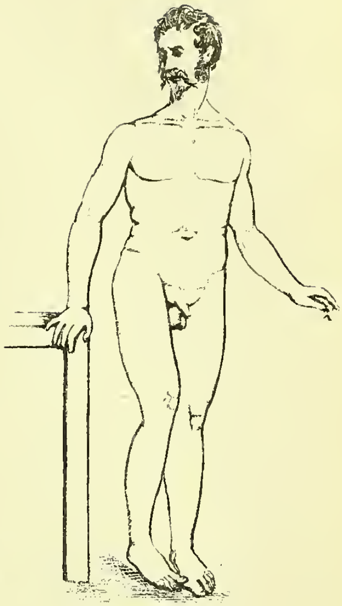


Fig 2.

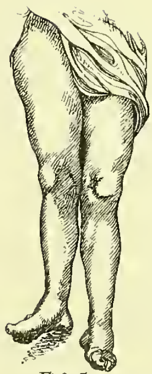


Fig 5.

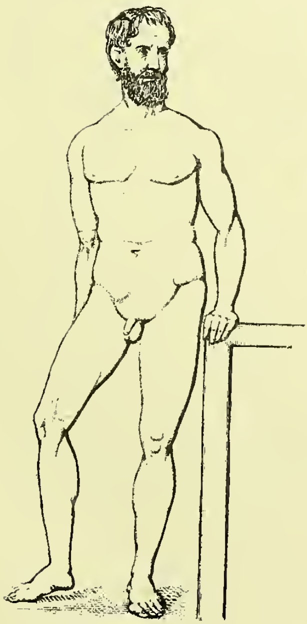


Fig 3

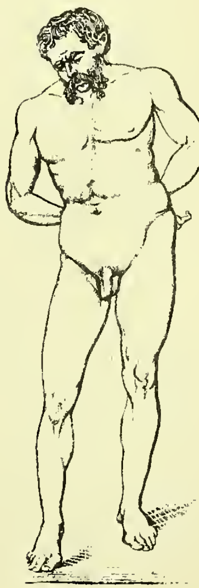


Fig 4

laterally on the bone so as to tilt the head and neck from off the surface of the ilium, in order that the force acting on it may meet with less obstruction (plate xix. fig. 1). In this way the head of the bone often slips readily enough into the acetabulum.

In dislocation into the ischiatic notch the direction of the extension is somewhat the same, only more oblique (plate xix. fig. 2). We require, in drawing upon the bone, to keep it away from the notch. The difficulty of reduction is greater in this luxation, and is partly due to the ligamentous textures. The head and neck of the bone also come in contact with the rounded surface of the os innominatum, near the acetabulum, thus causing an obstruction to the reduction. By tilting the head of the femur from the notch, whilst extension is made downwards and forwards, and the pelvis kept fixed, the reduction can generally be effected, though with a little more trouble than in the dislocation on the dorsum of the ilium. When the dislocation into the ischiatic notch occurs secondarily in reducing other luxations, there is generally no difficulty in effecting its ultimate restoration. The difficulties are much greater when it is a primary dislocation, especially if some time has elapsed after the receipt of the injury. We can sometimes reduce the dislocation with the hand when the case is seen early. This, however, does not often happen, in consequence of the great bulk and muscular power of the thigh. As a rule, therefore, when there is any difficulty, instead of wasting time in attempting to reduce the dislocation by the hand, we should try it with the pulleys, and in drawing on the bone with pulleys we must take care to keep up the force steadily and evenly, and not in jerks. You can sometimes facilitate the process of reduction by bending the knee across the opposite leg to a still greater extent than it has already assumed. You thereby make it act as a lever, by which the head of the bone is drawn outwards from its lodgment on the dorsum of the ilium, and where otherwise it would be firmly retained by muscles and other tissues. It is also occasionally advantageous to alter the directions of the force, and to rotate with the same object, for often during reduction, after the first part has been effected, the head of the bone may be checked in its course by becoming locked at the ridge of the acetabulum.

The manual method of reducing dislocations of the hip has been revived and used with great success; so much so, that the reduction of these luxations, which formerly entailed much trouble and the expenditure of great force, can now be effected in recent cases as if by magic. The patient is put under chloroform, and then, by flexing the leg on the luxated thigh, carrying it across the sound one, flexing it slowly upwards over the pelvis to the umbilicus, then abducting and rotating outwards, the reduction is accomplished. I have said that the use of the rotatory or circumduction method has been revived: perhaps I should rather have said revived as a general practice; for, in truth, it has never really been altogether abandoned. We generally hear it spoken of as the American method, and undoubtedly it is to the writings of Drs. Reid and Bigelow of the United States that we owe the more general use of the practice in this country; but it is not a little

curious that it has been so little known or used, seeing that it is mentioned and described in some of the principal French works on surgery —not old black-letter, but modern books, in the possession of most of us. Thus, in Nélaton's *Pathologie Chirurgicale*, published in 1847-48, there is the following statement in reference to dislocations of the hip:—"In 1835, M. Desprès made known a method which cannot be too highly recommended on account of its simplicity and the real services which it has rendered in certain difficult cases. . . . This method consists in flexing the leg on the thigh, the thigh on the pelvis, to exaggerate even the movement of flexion and adduction of the limb, then to exercise with it a gentle movement of rotation outwards, whilst at the same time it is abducted." This method, says Nélaton, is described by Pouteau in his *Mélanges de Chirurgie*. M. Chassaignac in the second volume of his *Opérations Chirurgicales*, 1862, speaks of this method of reducing dislocations of the hip, and quotes the text of Pouteau as follows:—" Surgeon-Major Maisonneuve, of the Regiment of Maugiron, a man of great merit, and trustworthy, assures me that he has reduced such luxations without the assistance of any extension. He first flexes the thigh at a right angle with the body; he then executes with the thigh a movement of rotation, which makes it approach the belly as nearly as possible, then carries it out towards the haunch, and returns it immediately by drawing it down towards the sound thigh." Pouteau adds that this method was known to the ancients, and that it is mentioned by Hippocrates and Paulus Ægineta. The accompanying woodcut is a copy of an illustration from a French

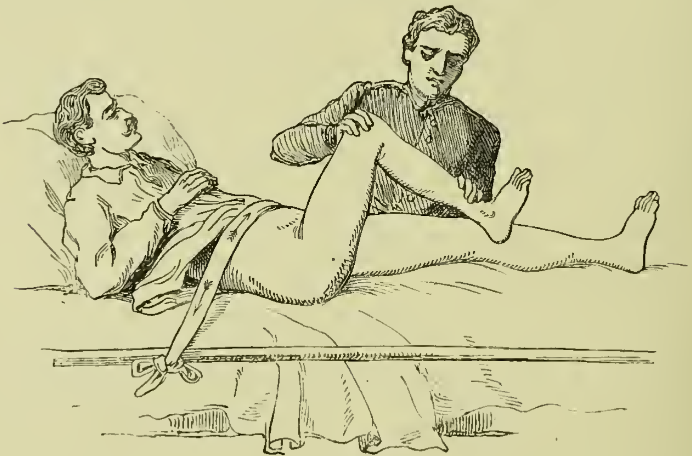


Fig. 47.

work on *Bandaging and Surgical Appliances*, by Dr. Goffrés, published at Paris in 1859, and shows the surgeon in the act of using the manual method of Desprès. For this I am indebted to my friend Dr. Paterson, formerly of Bahia. M. Chassaignac enters very fully on the principle of the method; and there is a curious sort of coincidence

Fig. 47. Represents a Surgeon making the last movement of the rotatory method of reduction of dislocation of the hip.

Fig 1
Fig 2
Fig 3
Fig 4
Fig 5

in terms between his use of the letter Y, to assist his description, and the use made of the same letter by Dr. Bigelow, to mean a totally different thing. Dr. Bigelow speaks of the Y-ligament as playing an important part in the rotatory method, describing the ilio-femoral ligament under that name, on account of the divergence of its fibres at their attachment to the femur. Chassaignac describes the leg and thigh, when bent, as representing a pair of compasses opened at a right angle, the lower or horizontal branch represented by the leg, the upper or perpendicular branch by the thigh—this latter divided at its upper extremity into two parts, like the letter Y, one part being fixed, represented by the ilio-femoral ligament, the other movable, represented by the head and neck of the femur,—and then proceeds to demonstrate how, by using the leg as the arm of a bent lever, whilst the ligament, being fixed, forms a pivot—the movable part—the head of the femur, is forced or directed to the acetabulum.

The other two dislocations of the hip are comparatively rare.

Dislocation of the head of the femur into the obturator foramen is the more common of the two. Here we have also symptoms of a very marked character, though perhaps not quite so striking at first as we might imagine from looking at the skeleton. This is the only dislocation in which the lower limb is lengthened. The lengthening is due to the position of the head of the femur, for it lies below its natural level. The foot points directly downwards, or is slightly everted, and the limb seems to lie away from the other (plate xviii. fig. 4). When the patient is lying flat on his back we find that we cannot bring the injured limb parallel to and in close contact with the sound one; and we cannot cross it over the opposite thigh without reducing the dislocation. I have seen what seemed to be an exception to this rule in the case of a patient who was very much in-kneed; but such exceptions are rare. There is another thing which strikes us on looking at the limb—namely, a depression corresponding to the point where the great trochanter was situated, instead of the elevation of the trochanter seen in the two former dislocations.

There are some cases which it is possible to mistake for this dislocation. The late Mr. Liston met with one of these in which the patient had suffered from incipient disease of the hip-joint, and had fallen on the hip, causing swelling, and all the appearances of dislocation. Mr. Liston asked him if he had ever been lame on that leg, and found that at the age of twenty he had been. I have had a similar case in my own hospital practice. I have also seen in young patients separation of the head of the femur, which might be mistaken for a dislocation; but, apart from such cases, there is seldom any difficulty in diagnosing this injury.

The method of reduction is simple. The pelvis is fastened by a sheet, and then another sheet is placed under the injured limb towards the upper part of the thigh, and brought over the neck of the assistant. The limb is extended a little at first, but not very much, for it is already longer than usual. We only extend it so as to overcome any muscular resistance, and then draw it inwards across the opposite limb, using the foot and leg as a lever to tilt the head of the femur outwards

from the thyroid foramen (plate xix. fig. 3). In this way the dislocation can easily be reduced. If we were to extend the limb in this case obliquely downwards and outwards, we would not be likely to reduce the dislocation, for we would be pressing the head of the bone away from the acetabulum.

Dislocation on the pubes is very rare indeed. The symptoms are shortening of the limb, eversion of the foot and knee, and a swelling felt upon the pubes where the head of the bone is lodged (plate xviii. fig. 3). I have never seen a case of this kind in the early stages, though I have seen an old case of unreduced dislocation on the pubes. The head of the femur lies upon the pubes, and on rotating the limb we have a very evident swelling in front. This stretches the vessels of the part and presses upon them to some extent, causing a certain amount of congestion. The heel also inclines towards the opposite one. This dislocation is said to resemble ordinary fracture of the neck of the femur, where there is eversion of the foot and knee, as in the dislocation (plate xviii. fig. 5). There should, however, be no difficulty in the diagnosis, for in the fracture we have not the head of the femur forming a swelling on the pubes.

This dislocation is not to be reduced in the same way as the others. We must, in this case, extend and tilt the bone in a particular way. The patient is placed on the opposite side, and here it will not do to draw straight down. The extension must be made backwards, so as to tilt the head and trochanter away from the pubes (plate xix. fig. 4). After the extension has been continued in this direction for some time, with slight rotation, the head of the bone will slip into the acetabulum; but it is useless to attempt reduction by drawing straight down at first.

After any dislocation has been reduced, the limbs are fastened together by a bandage, with a pad of wadding between the knees and ankles. Then a broad bandage or flannel roller is placed round the pelvis and firmly secured, so as to keep the parts perfectly quiet for some time, and allow the capsular ligament to unite as far as possible.

If there be much swelling in the neighbourhood, opiate fomentations must be applied, especially if great force has been required to reduce the dislocation. The bad symptoms generally pass off very soon, and in from four to six weeks the patient may be allowed to use the limb. If motion be allowed before that time, there is always a risk of the recurrence of the dislocation from the weakness of the capsular ligament.

When the dislocation is accompanied by a fracture of the pelvis, it is a very different matter, then the prognosis is always unfavourable.

LECTURE L.

Fracture of Neck of Femur—Intra and Extra Capsular—Diagnosis and Modes of Treatment—Fractures of shaft of Femur at different parts—Directions and causes of Displacement—Treatment.

FRACTURE of the neck of the femur, or separation of the head of the bone from the trochanters, occurs in a variety of ways, and may be caused by comparatively slight force. The fracture may be completely within the capsule of the joint, and it is then called intra-capsular; or it may occur external, to the reflection of the synovial sac, and also in a great measure beyond the principal attachment of the capsular ligament, in which case it is called extra-capsular fracture; or it may partake of both characters, being partly intra and partly extra capsular. The subjects of it are generally persons well advanced in life.

The general symptoms of this fracture, whether intra or extra capsular, are very similar after a time, so much so that there is considerable difficulty in the differential diagnosis. If the case be seen immediately after the accident has been sustained there are diagnostic symptoms which help us to distinguish the two injuries. We have shortening of the limb, eversion of the foot and knee, swelling about the trochanter, and great projection in that region (plate xviii. fig. 5). These symptoms occur in all cases of fracture of the neck of the femur, whether intra or extra capsular, after some time has elapsed, say from twenty-four to forty-eight hours. But in a purely intra-capsular fracture the symptoms are at first much less marked. There is eversion of the foot and knee, but there is very little shortening of the limb, not more than half-an-inch or so, and there is not much swelling at the hip. Sometimes it is very difficult to elicit crepitus. This is due partly to the depth at which the bone lies, and partly to the fact that blood and synovial fluid are effused between the broken ends. Then the two portions of the broken bone are not likely to correspond with each other, so that you might roll about the bone for a long time without ever bringing the fractured surfaces into contact.

The reason why intra-capsular is not marked at first by so much shortening as extra-capsular fracture is, that in the latter all the muscles which draw up the lower part of the thigh act upon it directly and at once, so as to make the displacement visible from the first, the capsule of the joint being torn through. Whereas, in the intra-capsular fracture, the capsular ligament surrounding the head of the bone attaches the two fragments so far to each other, and it is only after some stretching of the ligament that the lower portion is drawn upwards

and outwards. Hence, when there is marked shortening of the limb and trochanteric projection at the very first, the probabilities are that the fracture has taken place below the capsule, and the case may therefore be safely diagnosed as one of extra-capsular fracture, but when the shortening does not occur for some time, then we may consider it to be an intra-capsular fracture.

The late Mr. Smith of Dublin, in his work on fractures, drew attention to the cervical ligament of the femur, and considered that that texture prevents the immediate shortening in the intra-capsular fracture, but it seems to me that the attachment of the strong resisting capsular ligament is the real obstacle. It is important to know whether the fracture be intra or extra-capsular, for if it be the latter we have a very good chance of obtaining bony union, and then the limb again becomes useful, whereas in intra-capsular fracture osseous union is exceedingly rare (plate xv. fig. 5). Indeed, it is very doubtful whether the fracture ever unites by bone. In old people, it is not always advisable to persist in keeping on splints at the risk of the general health. If we know that we have to do with intra-capsular fracture we have less hesitation in leaving off the special treatment; whereas, if the fracture be extra-capsular, we are warranted in persisting, even at some little risk to the general health, in keeping on the retentive apparatus.

The eversion of the foot and leg, and the shortening of the limb, are generally explained thus:—The shaft of the bone, with the trochanters and neck, are drawn upwards and backwards towards the pelvis by the gluteus, medius and minimus, whilst the digital fossa, into and near which the external rotator muscles are inserted, being situated also in the trochanteric portion of the bone, the shaft of the femur is everted by these external rotators, which have no muscles to counteract them. It is perfectly true that the external rotators and glutei are the muscular causes of the shortening and eversion; but the weight of the limb causes eversion, as we see when there is no fracture, for when a person is lying on his back the limbs are naturally everted.

The difficulty of feeling crepitus depends, as already stated, on effusion of blood and synovial fluid within the joint and between the ends of the bone; but more generally this difficulty arises after shortening has taken place, and where there is considerable swelling. In the extra-capsular fracture, where the trochanter is considerably drawn up, if we rotate upwards and inwards we are not likely to cause crepitus, because then we do not make the broken surfaces of the bone meet, and it is only after extending the limb and then rotating that we can feel it. I have always found that the best method of eliciting crepitus is one which may be considered perhaps rather a rough plan. It is to bend up the limb forcibly, and then extend it suddenly downwards. We thus loosen the portions of bone from each other, and so produce crepitus very readily; but sometimes we do not require to adopt this plan when there is not much shortening.

As regards the results of intra-capsular fracture of the neck of the femur, it generally unites by fibrous texture. The uniting medium is a cartilaginous matrix, with fibrous texture in it, and although thin, is

pretty strong (plate xv. fig. 5). Even after this fracture, therefore, a tolerably useful limb may sometimes be left. In some few cases we find very unfavourable results. The head of the femur may become necrosed, and suppuration take place within the joint, leading to irritative fever and death of the patient. This result, of which I show you a specimen, is exceedingly rare. I have never seen a case of it during life, although it is, I think, remarkable that we so seldom meet with such cases. The head of the bone is broken off completely from the shaft. All the small vessels which pass into it must have suffered great injury from the fracture, and its only vascular supply is derived through the vessels of the ligamentum teres.

Certain cases of fracture at the neck of the femur may be mistaken for dislocation of the hip. In ordinary intra-capsular fracture the symptoms are somewhat like those seen in dislocation of the head of the femur on the pubes. No one, however, could mistake the two injuries, for in the dislocation we have the head of the bone projecting on the pubes, and we have also a certain amount of congestion in the limb, caused by the pressure of the head of the bone on the vessels in the neighbourhood. There is, however, a fracture of the neck, or upper part of the femur, which occurs chiefly in old people, and which simulates dislocation of the hip backwards. The force causing the fracture may be very slight, perhaps a mere fall in a room, generally on the hip. In the fracture just mentioned, the limb is shortened to a slight extent, the toes rest on the metatarsus of the opposite foot, the limb is drawn up, but the hip not so much swollen as in the ordinary fracture of the neck of the femur, and the knee is inverted, not everted as in that injury. This fracture is not a very common one. Its direction is very oblique, passing through the neck of the femur in front, close to the trochanter. The greater portion of the trochanter and the digital fossa posteriorly are left in connection with the head and neck of the femur. The external rotator muscles have nothing to counteract them, and therefore rotate the head of the bone outwards, while at the same time they draw the trochanter upwards and backwards. In front, again, if any part of the gluteus medius be left in connection with the shaft, it is only its anterior fibres, and these, along with the tensor vaginæ femoris, act as internal rotators, and turn it inwards. This readily explains the inversion of the knee. In this fracture the appearances at first are very like those of dislocation of the head of the femur into the ischiatic notch, but whenever we extend the limb it becomes everted, the toes turned out, all the signs of dislocation disappear, and then we see the true nature of the injury. In chronic rheumatic arthritis we may have all the symptoms of fracture of the neck of the femur, but the history of the case should guide us in our diagnosis.

As fracture of the neck of the femur occurs chiefly in old people, the first question for the surgeon to consider, with reference to *treatment*, is: Can the patient bear the application of retentive apparatus without great constitutional irritation? Now that we use the weight and pulley extension there is no difficulty in answering this question in the affirmative, for by that method all pressure is avoided, the movements of the limb are controlled, and the patient lies at perfect ease.

No lateral splints are necessary, and any tendency of the limb to roll outwards can be counteracted by placing sand-bags along the outside of the leg. As regards the long splint, if it be carefully applied and well padded, it will give more rest to the patient than could be obtained by leaving the limb loose. Therefore, in cases where we do not employ the weight and pulley, the long splint should be applied for the first few days at least. If the patient complains very much of the restraint arising from it, then it must be taken off; in this case the limbs should be brought together and fastened by a bandage, a pad being placed between the knees and ankles, and then a broad flannel spica-bandage round the hip. This will not prevent some degree of shortening, but we must try and keep the limb as quiet as possible when the patient cannot bear the splint. In some cases we may put the limb on a double inclined plane of pillows, and fix it so, the knee being bent at an angle. In this way the weight of the body is made to act as a counter-extending force. This method was recommended by Dupuytren, but I have not found it very efficient. The patient is restless, the pillows get displaced, and he often suffers much irritation from the movements of the fragments upon each other. In applying the long splint in such cases we do not use any force in extension and counter-extension. By padding the splint well, and placing the patient on a water-pillow, we find that, in a great many cases, the long splint may be kept on for the first eight or ten days. Afterwards it may be taken off, if necessary, for separation of the ends of the bone is not likely to take place after that time. If no constitutional symptoms require the removal of the splint, it should be left on as long as possible, and I must say that there are very few cases in which the splint cannot be applied, if proper care be taken. Bandaging the two limbs together is simply a way of making the sound limb act as a splint for the broken one. In some cases I have applied the splint on the sound limb, and then fastened the broken limb to it with advantage.

In Fractures of the Upper Part of the Shaft of the Femur the displacement is very great. The nearer the fracture is to either extremity of the femur the greater is the difficulty in the coaptation of the ends of the bone and in the treatment of the fracture. This is due to our having no power whereby to act on the smaller fragment, or to overcome the action of the strong muscles attached to it. In fractures high up in the thigh, for example, the upper fragment is elevated by the iliacus and psoas muscles, and the shorter this portion is the more power these muscles have in displacing it, and the less power we have in controlling them. When the fracture is lower down, the upper fragment has still a tendency to be drawn upwards, but not nearly so much as in the higher fracture.

In treating these fractures we must be very careful to bring the fragments into accurate position at first, and therefore I think it is advisable to put the patient thoroughly under chloroform, then extend the limb and set it very carefully, and apply the proper splints and bandages at once. In almost all fractures of the femur I prefer extension by means of the weight and pulley to any other apparatus; in this fracture it can be assisted by the use of short splints, so as to prevent

the elevation of the upper fragment. A small Gooch's splint is padded and placed on the front of the thigh to prevent the elevation of the upper fragment, and another is placed posteriorly, while extension and counter-extension are kept up by the weight and pulley. Some surgical authorities say that we should treat these fractures on the double-inclined plane, the angle of which should be made as acute as possible, and in this way the weight of the body lying flat in bed would act as a counter-extending power. I have never found this method answer very well in practice for keeping the parts in position. Whatever apparatus we apply we shall find great difficulty in this respect, but with the double-inclined plane the difficulty is greater than with the long splint.

There are a variety of forms of displacement in fractures near the middle of the femur. The upper fragment may be the riding end of the bone, and the lower end may project upwards and inwards, or upwards and outwards. If the fracture be low down, the inner condyle will be tilted inwards, while if it be a little higher up, it will be tilted outwards. These variations, in form of displacement, depend on the relations of the adductors to the point of fracture. In very oblique fractures the oblique planes of bone tend to glide upon each other, and we have the lower portion dragged upwards by the hamstring muscles, causing shortening of the broken bone, independent of the lateral deformity, and in such cases we require to be very accurate in the coaptation of the fragments. In transverse fractures of the shaft of the femur we can bring the two portions into accurate contact, and they can easily be kept in position, the one portion acting as a check to the other; but fractures are generally more or less oblique, and the slightest muscular power tends to move one fragment on the other.

The great tendency to shortening and deformity in cases of fracture of the thigh-bone, owing to the contraction of the powerful muscles which surround it, could not but attract the attention of those called upon to treat such injuries; and hence, from the earliest times, surgeons were naturally led to try to overcome the displacing causes by opposing force to force by means of *extension* and counter-extension. The principle of extension is now almost universally admitted to be best in these fractures; but the method by which it is applied makes all the difference. Those who first applied the principle seem to have had in view rather what mechanical forces could effect, than what the living body could bear. You have only to look at the formidable machinery they employed for the purpose, such as the bed of Hippocrates, the "organon," and the various forms of glossocoma, different kinds of racks and windlasses, in fact, to understand how a revulsion of feeling in the profession should have at one time led to the abandonment of the extension treatment in fractures of the thigh-bone, and to the adoption of the method of laying the limb on its outside, with the leg bent on the thigh, and the thigh bent on the pelvis—a principle of relaxing powerful muscles which had proved most useful in fractures of the leg, but which, for obvious causes, proved most disastrous in those of the thigh. The abuse of a power is not a reason for abandoning its use; we would do better to examine into it, and try whether it be not cap-

able of improvement. I fear, however, human nature has a bias to extremes; and so we often miss making improvements on methods of treatment until they suddenly reappear as novelties, and are accounted, and properly so, as marks of progress. Mr. John Bell, in his great work on *Surgery*, speaking of the machines used in treating fractures, says: "I may, perhaps, do you some service by explaining the simple principles of this department of surgery; and then you will be able to enter the magazines of Scultetus, Hildanus, and Pareus, filled with engines not unworthy of the chambers of the Inquisition, without being tempted to bring out along with you any of their lumber." Accordingly, he does enter the magazines of apparatus, and criticises them with his usual scathing sarcasm. Amongst other "lumber," he unhangs from the walls of the magazine of Hildanus a weight with circle and strap for hanging from the ankle, and drags to light a bed with a

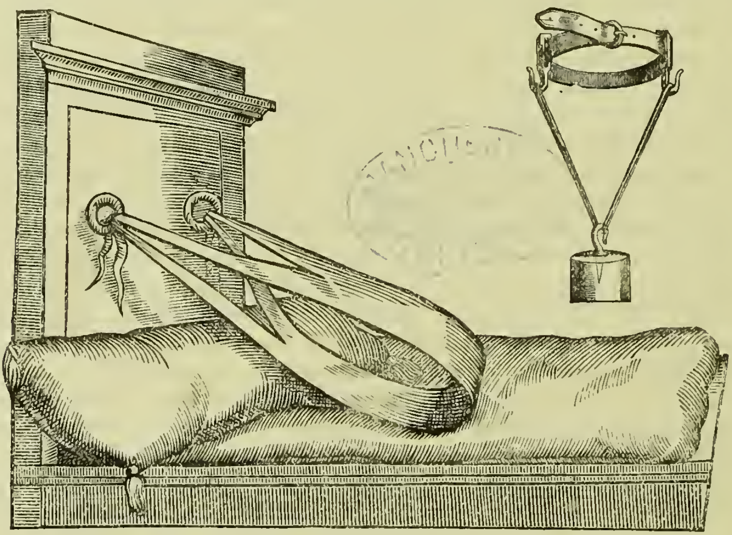


Fig. 48.

surcingle or perineal band of horse-girth for fixing the body to the upper part of the bed (fig. 48); and on this rude apparatus for permanent extension he makes ironically laudatory remarks. Mr. Bell would have been better employed if, when he exhibited the rude apparatus of Hildanus, and admitted its power of maintaining permanent extension, he had thoughtfully considered how its defects might be removed, and it might be converted into a simple and effective means of treating fractures of the lower extremity. Let me again take the dust off this bed and weight of Hildanus, and place them alongside some modern surgical upholstery, and see how like they are in principle. Here is the weight and pulley method copied from a recent work on surgery (fig. 49). How very like! The perineal band or surcingle fixing the patient; the weight hanging from the foot through the pulley fixed at the foot of the bed. But how is the weight hung from the limb? No longer by

Fig. 48. Bed of Hildanus, for effecting extension and counter-extension.

a circular strap round the ankle, acting on one part only, and so unendurable, but to long plasters fixed to and embracing a great breadth of the limb from immediately below the fracture, and so diffusing pressure that the patient feels no inconvenience, and is scarcely sensible of the extending force. That makes the difference. But something is still wanting to its perfection. Can we get rid of that perineal band, which proves so troublesome to patient, and surgeon, and nurse? How can we dispense with it, and maintain a counteracting force to the extension from the foot? Tilt up the lower end of the bed; place blocks of wood below the feet of the bed; take off the perineal band, and let the body be the counter-extending force; and there you have the simplest, least irksome, and most perfect method I know of treating fractures of the thigh, and, if possible, still more useful in treating oblique fractures of the tibia.

Until a comparatively recent date I seldom used anything but the long splint for the purpose of extension and counter-extension; and several years ago I drew special attention to what I considered

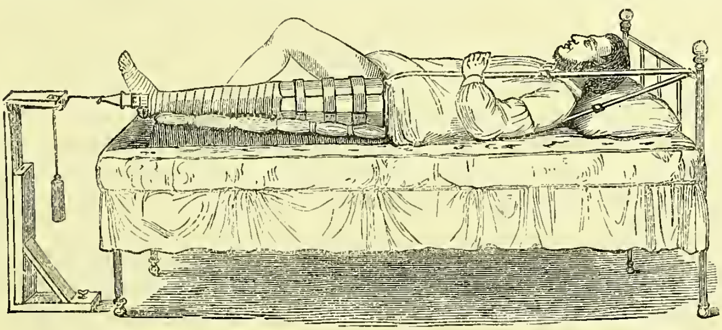


Fig. 49.

essential to its proper use, viz., maintaining a moderate amount of extension during treatment, more especially when the fracture was oblique; and, so far as the results of my practice were concerned, I had little reason to abandon the long splint for any other method. But it is impossible for any one who has had much experience in its use not to feel that it has defects, and that much care is required to prevent troublesome results, and to overcome some difficulties. I may mention, for example, the tendency to fretting and excoriation of the soft parts, caused by the perineal band or extensor, and by the handkerchief which was generally used for fixing the foot to the splint. Nay, unless great attention was given, the pressure of the handkerchief sometimes gave rise to sloughing, especially in old or very young patients. Indeed, for some years before I began to use the pulley-extension, I had used plasters as the means by which I fixed the foot to the lower part of the splint, so as to obviate the bad effects of the handkerchief round the ankle and instep, and also as maintaining extension in a more direct line, and preventing any eversion of the foot; and I would strongly urge this modification whenever the long splint is used.

Fig. 49. Extension by weight and pulley, from Erichsen.

But there still remained the inconvenience and irritation caused by the perineal band, and the frequent necessity of changing it for cleanliness; and when this band is removed, of course all extension and counter-extension cease for the time, unless kept up by assistants; and there is risk of displacement occurring. Another troublesome though less serious effect was the stiffness of knee when the splint was removed at the end of six or seven weeks; and, in some patients of rheumatic diathesis, or those who would not tolerate early passive motion being used, I have known a considerable amount of stiffness remain for years. My predilection for, and my favourable experience in the use of, the long splint, made me very unwilling to abandon it; but, having to treat a compound fracture of the thigh where the wound was so placed that even the bracketed long splint could not be used, I tried the extension-pulleys, and found that method so effective that I tried it in ordinary cases, and have found it so simple and effective, so much more comfortable for both patient and surgeon, that I now rarely use the long splint—almost never, except for clinical instruction, that students may see more than one method of treatment. Now, after some years' experience in the use of the extension-pulleys in fractures of the thigh in very young children and in adults, in fracture of the neck of the femur in old persons, and in long oblique fractures of the tibia, I unhesitatingly commend the method to all who may not have tried it. Of course, in fractures of the shaft of the femur, lateral splints are required, just as when we use the long splint, and also for lateral support in fractures of the leg. When there is much bruising, however, I merely use sand-bags to prevent lateral displacement; and I also prefer deep sand-bags to prevent rolling of the limb outwards in fractures of the thigh, to a long lateral splint, as used in America. In fact, the full advantages of the extension-pulley method are only secured when we abandon the perineal *lacque* and long lateral splint, and make the body the counter-extending force.

In all cases of fracture of the shaft of the femur I now almost invariably use extension by weight and pulley. We must put on anterior and posterior or lateral Gooch's splints, so as to prevent any antero-posterior or lateral displacement. In transverse fractures of the shaft of the femur, where the one fragment checks the other, there would not be much likelihood of displacement after the fracture had been set. In oblique fractures the slightest force or movement tends to cause the bones to glide upon each other, and the use of the extension apparatus is just to prevent this.

LECTURE LI.

Fracture of Condyloid Extremity of Femur—Displacing Causes—Treatment—Description of the method of using the Apparatus for Extension by weight and pulley, the Long Splint and Double-Inclined Plane, in the different Fractures of the Femur—Fractures of the Patella—Displacing Causes—Method of Treatment—Evulsion of the Ligamentum Patellæ—Its Diagnostic Appearances—Nature and Treatment—Dislocations of the Patella.

In fracture of the lower end of the femur, near its condyloid extremity, the displacement is very characteristic. The lower fragment is invariably drawn backwards behind the upper, which remains very nearly in its natural position. In some cases from the action of the tendon of the adductor-magnus, the upper end of the lower fragment is thrown a little outwards. When the fracture is close to the condyloid portion of the femur, the lower fragment is bent directly back towards the leg. The cause of this displacement is the action of the gastrocnemius and popliteus muscles, which are attached to the lower part of the femur. These muscles are not counteracted by any of the extensors in front, as the latter all pass over the joint. When the fracture is very low down, the small lower fragment is bent back on the leg to such an extent that it is very difficult to bring it in line with the upper part of the femur. In treating this fracture, the great point is first to bring the parts as nearly as possible into apposition. In order to do this, we generally require to put the patient under chloroform so as to overcome all muscular resistance and enable us to model the broken parts accurately together. We then stretch the leg downwards and press the lower fragment upwards, so as to bring it into contact with the shaft of the bone. A padded splint is then placed behind, but the pad must not press directly into the popliteal space, lest it interfere with the circulation. Its use is to prevent in some degree the lower fragment from being drawn backwards again. The limb is then put straight, and the extension by weight or the long splint applied. The fracture can be generally very well treated in this way, though in some cases there may be a difficulty, and therefore some prefer the double-inclined plane to the long splint. For my own part I always use the latter, with a Gooch's splint behind the fracture. In fractures of the condyloid portion of the femur, splitting or fissure into the knee-joint is not uncommon. It is a very unfavourable complication.

I would now direct your attention to the use and mode of applying the different apparatus used in treating fractures of the thigh.

The method of Extension by Weight and Pulley. The fracture having been reduced and adjusted, whilst the limb is kept steady by assistants maintaining extension and counter-extension, the surgeon applies two

long strips of dimity adhesive plaster from immediately below the site of fracture to the maleolus on each side of the limb. These plasters should be of considerable breadth above, and they should gradually narrow towards the maleoli. To the lower extremity of each a piece of stout webbing is firmly stitched. Unless these plasters be very *slightly* heated they will be very apt to slip; they should be moulded to the limb by the hand, the warmth of which, along with that of the limb, is almost quite sufficient to cause firm adhesion. Prominent parts are apt to be chafed by these plasters, and thus we place a thin piece of lint between them and the sides of the knee and also over the maleoli, or at the ankle a turn of the calico bandage is passed between the maleoli and the plasters, (fig. 50). A roller is then applied over the plasters

Fig. 50.

to the fracture, and at this point the plasters are cut up into tails, one of which, on each side, is turned down under a turn of the roller, to assist in fixing it; then the roller is continued over the others. When this has been done the tapes at the ankle are passed through buckles attached to the sides of a square piece of board of greater breadth than the sole of the foot. In the centre of this piece of wood is a hole through which the cord which sustains the weight is passed, and is fixed on the side of the board next the sole by a transverse bar of wood, or by simply knotting it.

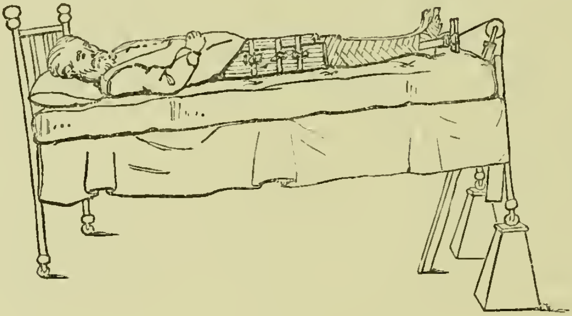


Fig. 51.

A long squared bar of wood, with a sheaved pulley fixed at its upper end, is now firmly lashed or fixed to the lower end of the bed, directly in a line with the broken limb; this end of the bed is then tilted up by placing high blocks under the feet. Lastly, the weight is attached to the cord, and the cord placed over the pulley, and the extension is completed (fig. 51).

Fig. 50. Method of applying the plasters in extension by weight and pulley.
Fig. 51. Extension by weight and pulley in a case of fracture of femur.

In cases of fracture of the neck of the femur this is all that is required, but in fractures of the shaft, padded Gooch's splints are applied around the thigh, to prevent lateral or antero-posterior displacements (fig. 52).

If the patient be very restless, or if there be tendency of the limb to roll outwards, sand-pillows should be used, and these are also useful when there is great swelling and bruising of the part, contra-indicating the use of Gooch's splints. The sand-bags should not be too full, or they cannot be moulded to the limb; and several short pillows are better than a single long one, for in the latter case the sand gravitates to one point, owing to the inclination of the bed. As to the weight to be suspended to the limb, that varies according to the size and muscular power of the individual. I usually judge by trying to what extent the patient can bend the knee, but from 12 to 15 lbs. is a sufficient weight to begin with in the adult. After a fortnight or three weeks the weight may be gradually decreased, any tendency to shortening being carefully watched.

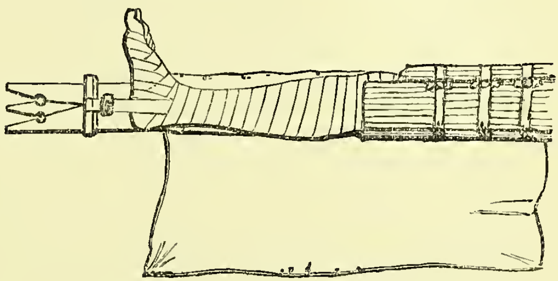


Fig. 52.

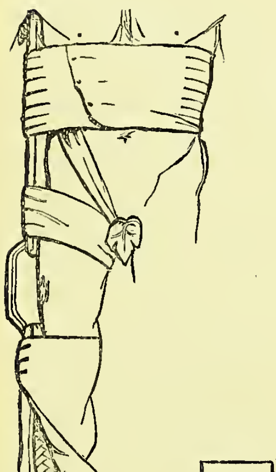


Fig. 53.

The Long Splint, as its name indicates, is a long wooden splint, reaching from the axilla to about four inches beyond the heel, with holes bored in it at the top and bottom. This is rolled up in a sheet, which should be thick enough to form a pad as it is rolled round the splint, a part being left free to encircle the limb and splint. The limb is brought straight, and the splint is laid along the outer side of it in readiness to be fastened there by means of the sheet (plate xvii. fig. 1). The perineal band consists of a handkerchief passing under the perineum and tied through the holes in the upper end of the splint. The holes in the bottom of the splint are generally used for fixing the foot to it by means of a handkerchief. For several years past instead of using the handkerchief to fix the foot, as represented in plate xvii. fig. 1, I have used plasters applied to the limb, as in the weight and pulley method, and a piece of stout tape or bandage cloth, passed through the

Figs. 52 and 53. Method of fixing the foot to the lower end of the splint by means of plasters and tapes. The latter shows the bracketed long splint for compound fractures, and also an isolated foot-piece.

holes at the lower end of the splint and tied there. By this modification we avoid all pressure on the instep or ankle, and secure extension of the limb in a straight line, without any of the eversion of the foot which the drag of the handkerchief is apt to produce (figs. 52 and 53). The sheet is then brought round and pinned, so as to fix the limb. A broad flannel bandage placed round the body so as to keep the splint perfectly fixed, completes the apparatus. In fracture of the neck of the femur this is all that is required. In fractures of the shaft, two Gooch's splints are padded and placed anteriorly and posteriorly or laterally—one on the outside, the other on the inside of the thigh, according to the nature of the displacement, and fastened there with slip-knots; the knots being always tied over the anterior or the inner splint. The perineal band is the most important part of the apparatus. It forms a counter-extending power as we draw it up, and it also forms an extending power from its being fastened to the upper end of the long splint, and forcing it down when tightened. We must take care not to attempt to extend by tightening the handkerchief or tapes at the foot, for if we do, we push up the long splint, and with it the lower fragment of the femur, and so certainly cause shortening of the limb. The slip-knots which secure the Gooch's splints must be tied on the splint in front or on the inner side of the limb, for if tied on the outside, whenever they require to be tightened or loosened, the long splint must be so far displaced, which is avoided if the knots are on the inner side. Sometimes the long splint is fastened to the limb by a roller instead of the sheet; but this is very troublesome, because when we want to look at the fracture we are obliged to undo the whole bandage. The sheet should be fastened with large pins, so that we can then examine the fracture without displacing the splint (plate xvii. fig. 1).

Although, as I have stated, I much prefer the extension by weight and pulley, I wish to take this opportunity of stating more fully my views regarding some principles to be attended to in treating fractures of the shaft of the femur with the long splint. Doubtless, in every case, the careful setting of the fracture at the first, making sure that the broken limb is fully the same length as the sound one, and that there is no obliquity of the pelvis, or other source of fallacy, which might deceive as to the apparent length, is all important and essential. No one can be more opposed than I am to the use of the long splint as a rack to elongate forcibly an imperfectly adjusted fracture of the femur. On the other hand, I am equally convinced that, however well adjusted at first, there will be great danger, almost certainty, of retraction and shortening, unless we keep up the extension we have effected, for the first ten or fifteen days at least. In a fracture of the femur, the extensor and flexor muscles alike tend to shorten; and as the displacing muscles are pretty equally balanced, we cannot relax them as in treating a simple fracture of the leg. Hence, if the extension and counter-extension be not kept up, the muscles tend to draw the broken fragments over each other. If all fractures of the femur were transverse, so that the broken surfaces, when properly adjusted, would serve to check each other when lateral displacement was prevented by the lateral splints, or if muscles ceased to act whenever the fracture was

set, then our plans of treatment might be much simplified. Unfortunately, fractures of the femur are often oblique, and the opposed planes tend to glide upon each other and produce shortening from very slight movement, and muscles contract and cause displacement even after the most careful adjustment. For these reasons, I hold that we must take means to prevent such shortening by *keeping up the extending power, not increasing it—merely keeping the advantage we have obtained*—and all that is required for this purpose is to keep tight the perineal band at the upper part of the splint, which, by pressing down the splint, retains the limb of the proper length. I have more than once seen surgeons proceed to increase extension by tightening the handkerchief or bandage which fastens the foot to the lower part of the splint, the effect of which is simply to push up the splint, and with it the lower broken portion, and so cause shortening. If the lower bandage requires to be re-adjusted, extension and counter-extension should either be made by assistants, as when setting the fracture originally, or else firm counter-pressure should be made by an assistant pressing down or fixing the splint from above whilst the foot bandage is being tightened.

The long splint is applied on the principle of keeping up a moderate amount of extension. I should not like to treat any fracture of the femur by the long splint without the perineal band, which acts both as an extending and counter-extending power, preventing any slight shortening which might otherwise occur, and unless we use it we are very apt indeed to have shortening of the limb.

In adjusting fractures of the femur at first, I make it a rule that the fractured limb should be fully half an inch longer than the sound one, so as to allow for the yielding of the intervening articulations of the knee and ankle.

The double-inclined plane, or Liston's splint, is an improvement on M'Intyre's splint (plate xvii. fig. 5). When applied it should be well padded, so that the limb may rest *on* rather than *in* the splint. The lower part of the splint is fastened to the bed, or slung. Care must be taken not to let the patient's heel fall through the large opening at that end of the splint. A slip of bandage should be placed across it to prevent this. In this splint the weight of the body acts as a counter-extending power. It answers very well in certain fractures of the thigh, but, as a general rule, I prefer the extension by weight and pulley, or the long splint, in these cases. For, if the lower end of the femur should come below the angle of the splint, it would be projected upwards, and cause deformity if not remedied. In certain fractures of the leg this is a most useful splint, especially if the fracture be either compound or comminuted.

Fracture of the Patella is very common, and results from the patient falling or receiving a direct blow on it. The fracture may be either transverse, oblique, or stellate. In transverse fracture of the patella the two fragments are widely separated from each other, the upper being drawn upwards by the quadriceps extensor femoris, and if the thigh be flexed the distance between the fragments is increased. In the stellate and oblique fractures the different portions of the bone

are attached to the ligamentum patellæ, and also to the quadriceps extensor, and there is therefore no displacement, whereas in the transverse fracture the displacement is very marked. Fracture of the patella is analogous to fracture of the olecranon in the upper extremity. The fragments do not often unite by bone, but by a strong fibrous texture. The usefulness of the limb afterwards depends a great deal on whether the uniting medium be long or short. If it be long, there will be very little use of the limb afterwards. If it be short, the limb will be as useful as if the union had been by bone. In fact, I have seen a second fracture occur through the bone, while the fibrous uniting medium of the former fracture had not given way.

Fracture of the patella, like that of the olecranon, is one of the most simple to treat. All that is required is to place the limb on an inclined plane, the heel must be raised, the foot fixed, and the limb slung (plate xvii. fig. 2). After a few days we can put up the fracture in a long Gooch's splint, with a bandage from the foot to above the patella, the limb being slung as before. This position relaxes the quadriceps extensor, and allows us to bring the fragments into pretty accurate contact. At first there will be a good deal of swelling, and therefore we cannot attempt to drag the two fragments forcibly together. We must wait till the effusion disappears, which it very soon does, and then we can act on the fragments and try to force them together by a figure-of-eight bandage, which will keep the parts in position quite as well as any special apparatus.

Lately I have treated some cases of transverse fracture of the patella, by means of Malgaigne's hooks, applied through the medium of thick plasters.

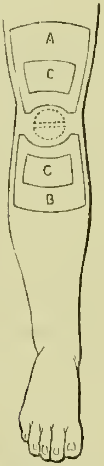


Fig. 54.

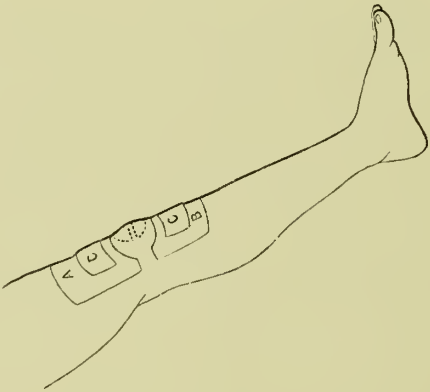


Fig. 55.

Although the screw-hooks designed by M. Malgaigne for transverse fracture of the patella are perfect as a mechanical contrivance for maintaining the fragments in accurate apposition, they have never yet been very generally used, owing to the pain and irritation caused by their

sharp points when inserted through the skin into the broken fragments of the bone. Of late years I have adopted a method of using these hooks, which I find to answer the purpose admirably, without inserting the hooks through the integument. The two fragments of the patella being held by an assistant in as close apposition as the effusion in the knee-joint will permit, I apply a broad piece of strong moleskin adhesive plaster, of the shape shown in figs. 54 and 55, to the thigh, above the upper fragment of the patella, and another piece of plaster, of the shape shown in figs. 55 and 56, from the upper part of the leg to the lower fragment of the bone. On the space marked C in the figures, two or three layers of plaster are applied to protect the skin from the points of the hooks, which are inserted there above and below the fracture, as shown in figs. 56 and 57. The screw is then gradually tightened, and

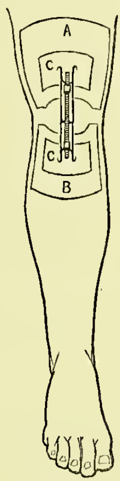


Fig. 56.

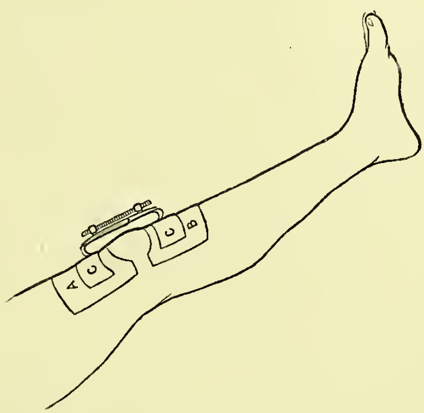


Fig. 57.

the fragments are approximated and kept in apposition. The screw requires to be tightened from time to time, and thus the fracture is kept accurately adjusted and in close apposition, without any circular constriction of the limb. Care must be taken to have the integuments on the stretch when the plasters are applied. The plasters should not be much heated, otherwise they would be liable to slip, and they should be firmly adherent to the skin for some time before the hooks are inserted, or traction made on them by using the screw. For greater security against the plasters slipping, the main portions may be made sufficiently long to encircle the limb, and supported for twenty-four hours with a few turns of a roller. I prefer, however, the method described, as the plasters, if carefully applied, generally hold firmly, and should they yield they can be easily reapplied. I may mention that I have also tried this method in treating rupture of the ligamentum patellæ, but it does not answer so well in that injury as plasters with straps, one passing on either side of the patella, from the upper plaster to buckles fixed on the lower plaster. In both these injuries the limb

should be placed on an inclined plane; or, better, slung at a corresponding inclination.

Evulsion of the Ligamentum Patellæ is a rarer accident than fracture of the patella. Some say it may be mistaken for fracture, but in the rupture of the ligament of the patella the whole bone is drawn up in front of the thigh, and with it a portion of the ligament, while, in the fracture, the lower fragment is always distinct and movable. Immediately after the accident happens a good deal of swelling occurs. There may be a slight projection of the upper part of the tibia, but it is not movable, and cannot be mistaken for the lower fragment of the patella. This injury seems to arise from violent action of the extensor muscles of the thigh. The patient, by a violent effort, tries to save himself from falling, and the knee at the time being bent very forcibly, the violent contraction of the quadriceps extensor causes the evulsion of the ligament of the patella. The treatment of this injury is exactly the same as that of fracture of the patella, though it is a little more troublesome. Because in it we have no two fixed points to bring together, and therefore we must employ a little lateral pressure. The limb is placed on an inclined plane, and slung and bandaged as before, but here we require to take care to prevent the ligamentum patella from forming a new adhesion laterally. In fracture of the patella there is not this risk. The parts must be kept in very accurate position, and the limb on the inclined plane for at least seven or eight weeks, which is longer than is necessary in fracture of the patella. In fact the limb ought to be kept in the straight position by means of a splint or starched bandage for some time afterwards, so as to prevent any muscular action affecting the newly-united parts.

I have now seen three cases of evulsion and one of rupture of the ligament, and in all the patients have regained the use of the limb with a very short uniting medium. I have also seen rupture of the connection of the extensor muscles from the upper part of the patella, the bone falling forwards and a gap left above the patella.

Dislocations of the Patella are of rare occurrence, and may be either *lateral*, the bone being displaced outwards or inwards on the inner or outer condyle of the femur, or they may be *vertical*, the patella being so altered in position that its edges look backwards and forwards, and its surfaces laterally. These dislocations very generally occur in patients in whom there is weakness or relaxation of the fibrous textures connected with the patella, and a tendency to effusion within the joint may be regarded as a predisposing cause.

The lateral displacement is the most common, and is usually described as being most frequent in the outward direction. Although I have had many patients under my care for the effects of this displacement, I cannot recollect ever having seen or having had to reduce the luxation, the patella had always been reduced either by some movement of the limb or by the manipulations of the patient at the time. The orthodox method of reduction is to bend the thigh on the trunk, and extend the leg on the thigh to relax the extensor muscles with which the patella is connected.

The vertical luxation is rare, and formerly was difficult to reduce; from the ligamentum patellæ being twisted, the limb nearly extended, and the muscles tense, the method employed, viz.—relaxing the extensors and pressing upon the bone—being seldom successful. The late Mr. Vincent of St. Bartholomew's, however, pointed out that by bending the leg upon the thigh and slightly rotating the tibia, the dislocated bone could be easily replaced, and this is undoubtedly the method most likely to succeed in reducing the vertical luxation.

It is, however, the after effects of these injuries that the surgeon is most generally called on to treat. At first, rest and the use of evaporating lotions, and subsequently gentle bandaging, are indicated. Afterwards the use of the warm douche with friction. Subsequently the patient should wear a laced elastic or leather knee-cap to give support and prevent recurrence of the accident, and the cold douche may then be used with advantage.

LECTURE LII.

Dislocations of the Knee-Joint—Question of Primary Amputation or Resection—Diastasis in Children simulating Dislocation — Fractures of Bones of Leg—Transverse and Oblique Fracture of both Bones immediately above the Ankle—Different methods of Treatment—Fracture of Fibula at its Upper and Lower Parts—Pott's Fracture, with Dislocation—Fracture of the Internal Malleolus—Methods of Treatment—Dislocations of the Ankle—Compound Fractures about the Ankle—Dislocation of Astragalus—Dislocation of Tarsus—Fracture of the Os Calcis—Fractures of Metatarsus.

Dislocations of the Knee-Joint are not common; when they do occur, the force causing the injury is generally such as to necessitate amputation, for the popliteal vessels are usually much injured. In some few cases we do meet with dislocation of the condyles of the femur from the tibia without serious complication, and then our treatment is limited to attempting to reduce the dislocation and save the limb. In the first instance, even though the circulation behind the knee may be interrupted, we cannot be sure the popliteal vessels are injured, for the condyles of the femur may be pressing on them so as to stop the circulation temporarily. Lesion of the vessels does generally occur in this injury, but not necessarily so, and when the dislocation is not compound, that is, when there is no opening into the knee-joint, we should always try to reduce it. After the reduction the circulation should be restored at the ankle, and if it does not return soon after the pressure has been removed and the shock has passed off, then lesion of the popliteal vessels has probably occurred, and the question of amputation has to be considered.

In compound dislocation we generally find the popliteal artery and vein twisted and torn from the great amount of force causing the injury, whilst there is often a considerable amount of bleeding from the smaller vessels. In other cases when the skin is cut through, and the condyles of the femur project while the vessels remain uninjured, the question of excision must be considered. When there is nothing to contraindicate this operation, and when circumstances enable us to treat the patient properly, it is certainly far preferable to amputation, and causes less shock to the system, but it is not suitable in cases where the soft textures around are much injured.

The appearances of dislocation of the knee-joint vary in different cases. For example, the condyles may be turned outwards and the bones of the leg thrust backwards, the patella being drawn inwards. In such a case reduction could be effected easily enough by extension and counter-extension, and then flexing the limb. When the disloca-

tion has been reduced, the limb must be kept quiet for some weeks by means of a splint and bandage. Afterwards, gentle passive movement of the joint should be commenced, lest the parts should become stiff from fibrous anchylosis.

Another injury which is very likely to occur in young children, and which might be mistaken for dislocation of the knee-joint, is diastasis of the condyloid portion of the femur. All the injuries about the knee-joint are comparatively rare, but if the case be seen early, the above rules ought to be followed out, and applied according to circumstances.

Fractures of the Bones of the Leg are amongst the most common accidents in surgery. They occur either from direct or indirect violence. If from the latter, then the weakest parts of the bones give way. For example, should the fracture occur by the patient jumping from a height, it generally takes place at the neck of the fibula and low down in the tibia; but the lower part of the fibula is likewise weak, just opposite where the tibia is fractured, and it often gives way there also, so that then the fibula is fractured in two places, as in this specimen. The fracture may, however, occur at any point. In young subjects especially we meet with a direct transverse fracture of the tibia and fibula with little or no displacement, so much so that the diagnosis is often difficult, but in this case we make the bones move laterally, and we can then feel crepitus. In other cases the displacement which occurs is very marked. In oblique fractures, whether the obliquity be in the antero-posterior or in the lateral direction, the displacement and shortening are very great. If the fracture be oblique from behind upwards and forwards, there is great displacement of the lower fragment, the foot and heel being drawn back by the action of the gastrocnemius and soleus. If the fracture occur transversely, close to the tubercle of the tibia, there is no displacement forwards of the lower fragment, but the upper portion is raised and tilted forwards by the action of the extensor muscles. If the tibia be fractured about the middle, the projecting ends of the bone can generally be felt readily. As we approach the malleolar portions of the bones, the fractures become much more complicated. Separation of one malleolus is apt to be attended with considerable displacement, and separation of both malleoli is always attended with great displacement of the foot backwards. When the bones are broken transversely, immediately above the malleoli, the lower fragment with the foot are retracted, while the shafts of the bones are pushed forwards.

In fracture of both bones of the leg about the middle or upper part, the bones must be accurately adjusted at first, and in the oblique fractures the treatment must be very careful throughout.

The general method of treatment which I adopt, and which I find far the most satisfactory in fractures of both bones of the leg, when they are not very oblique, and when there is not any very great displacement, is to apply two lateral pasteboard splints. The limb is flexed and laid on the outside, and the splints, which are first moulded to the limb, are then applied. In applying them we should see that the greater part of the foot-piece corresponds to the sole of the foot.

The sole-piece is of great assistance in keeping the foot in proper position at right angles to the leg. A figure-of-eight bandage to above the ankle secures the foot-piece completely; a narrow pad is placed in front, and slip-knots are applied to keep the rest of the splint in position (plate xvii. fig. 7). The advantage of this plan is, that we can trace the line of bone in front, and see how the fracture is lying without disturbing it. If we find that the heel gets drawn backwards, or that any other displacement occurs, the splints must of course be re-adjusted. The limb requires to be bent at different angles according to circumstances. When the fracture is towards the lower third of the leg, or when there is a tendency to retraction of the heel, the leg must be flexed towards the ham, so as to relax the gastrocnemius, which is the chief displacing cause. When the fracture is higher up, we do not require to flex the limb so much. By attending to these rules, and by keeping the splints carefully applied, you will find this to be the best and simplest method of treating simple fractures of both bones of the leg.

When we have a very oblique or comminuted or compound fracture, or where the fracture is very high up, Liston's splint, well padded, answers better (plate xvii. fig. 5), as giving greater power of extension and preventing the fragments moving on each other. The foot should be supported by a handkerchief placed under the heel, and this should be fastened to a hook in the foot-piece. I object to the application of a continuous roller round the splint, for then we cannot tell how the limb is lying without undoing the bandage. It is far better to have a few slip-knots, or interrupted circles of bandage, and then we can see how the fracture lies, and can adjust any little displacement, if it occur, without much trouble. As a general rule, in all cases of fracture of both bones of the leg, the position of the limb should be such that the ball of the great toe and the inner edge of the patella are in a line with each other. There is one rule which I would lay down regarding this splint—namely, that in all fractures at or below the middle of the leg the thigh-piece should be brought as much as possible to a right angle with the leg-rest. In oblique fractures the upper portion of the tibia gradually becomes forced down, causing displacement; and the remedy for this is to increase the angle of the splint, and sling the foot so as to prevent the thigh from pressing downwards. We should not let the patient see how the angle of the splint is adjusted, for he is very apt to alter it himself, as every splint feels irksome at first. Another point is, that the foot-piece should be as nearly at a right-angle as possible.

Of late years I have seldom found it necessary to use Liston's splint, or any other complex apparatus—the extension by weight and pulley being equally or even more effectual, and managed with less trouble or disturbance to the patient. In long oblique fractures of the tibia it may be said to be perfect as regards extension (fig. 58), and when lateral splints are applied, as described below, for simple fractures of the leg (fig. 59), all displacement is prevented. By using two separate pads or towels in front, making their ends overlap over the point of fracture, and placing one of the slip-knots over that part, we can un-

loose and turn back the ends of the pads so as to examine the fractured point without disturbing it. When the fracture is very low down,

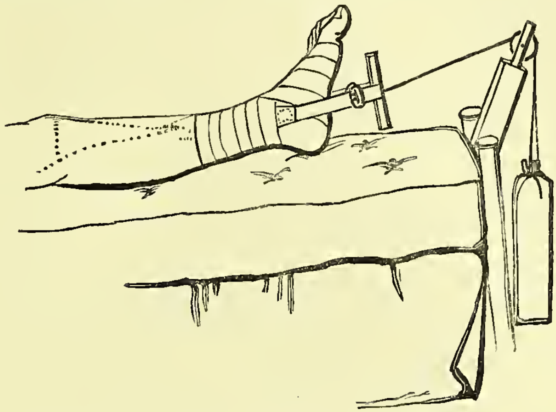


Fig. 58.

however, a considerable difficulty is met with. The plasters have not a sufficient hold, and are apt to drag. In such cases I would advise a

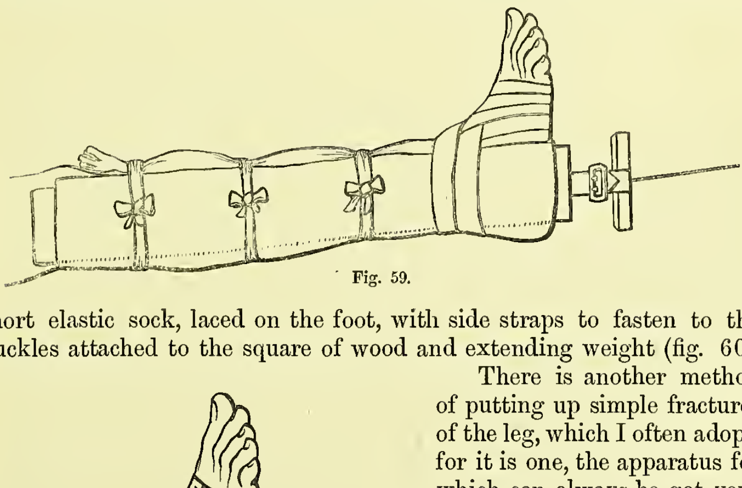


Fig. 59.

short elastic sock, laced on the foot, with side straps to fasten to the buckles attached to the square of wood and extending weight (fig. 60).

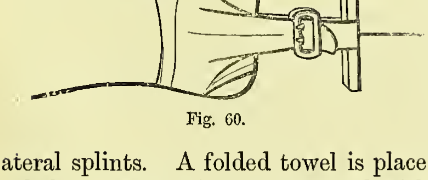


Fig. 60.

There is another method of putting up simple fractures of the leg, which I often adopt, for it is one, the apparatus for which can always be got very readily, and it answers the purpose very well. It consists of two thin flat pieces of wood or lath, which should be of a sufficient length to reach from the bend of the knee to beyond the heel. These are rolled up in a sheet, so as to form two lateral splints. A folded towel is placed as a pad in front of the limb, and the apparatus is then fastened with slip-knots and a figure-of-eight bandage round the ankle (plate xvii. figs. 3 and 4). The splints should

reach well below the foot, so as to allow us to fix it properly; and the leg should be placed on a pillow, or slung with the knee considerably bent. The leg is not laid on its side, but lies on the posterior aspect. This apparatus answers in most cases where we would use the double-inclined plane, and is of great use in emergencies. In all cases of fracture of the leg, when Liston's, or the lateral splints are used, the limb should be fastened to the bed, or slung so as to prevent the patient from moving it.

In fractures low down a posterior splint is sometimes applied to prevent the heel from being drawn backwards. In other cases an anterior splint is necessary. This latter is called the "stirrup splint;" it is used in cases where the malleolar portions of the tibia and fibula are broken, the foot drawn backwards, and the upper fragment of the tibia pushed forwards. The stirrup splint is well padded, and applied on the front of the limb, fastened on with slip-knots, and a bandage at the ankle, the bandage being brought under the heel. This is most important. For if we apply it higher up we are apt to cause greater displacement, as we do not then bring the heel forwards to the splint (plate xvii. fig. 8).

The stirrup splint answers admirably also in dislocations at the ankle-joint, in preventing any return of the displacement. If there be any tendency to lateral displacement we may prevent that by applying two narrow pasteboard splints, so as to give lateral support, while we also press the heel forwards. In these cases there is often inversion or eversion of the foot, and by the use of the stirrup splint we can prevent the retraction of the heel, and at the same time turn the foot either inwards or outwards, by using the outer or inner horn of the splint as a fulcrum over which to turn the foot. If we want to evert or invert the foot, to prevent displacement recurring, we can do so with the stirrup splint without applying any other apparatus. This form of splint certainly gives power in drawing the heel forwards, and in keeping back the bones of the leg; but, unfortunately, in many cases, which would otherwise be suitable for it, we cannot apply the stirrup splint, from the injury to the soft parts in front, which is often present, and on account of which the patient cannot bear the pressure in front. Before the stirrup splint came into use, Baron Dupuytren's plan was that generally adopted—namely, a posterior splint. When there is great retraction of the heel, with bruising on the front of the leg, then we may apply two lateral pasteboard splints, somewhat narrower than usual, so as to prevent any lateral displacement, and a well-padded Gooch's splint at the back of the leg, which keeps the heel into position, and prevents any possible retraction (plate xvii. fig. 6). A more extended experience of this has afforded such results that I now use it generally in preference to the stirrup splint.

When the fibula alone is fractured, at the upper or middle part, we can hardly tell that there is a fracture, for it generally occurs transversely, and the fragments are kept in position. The fracture gives rise to pain only on movement, and is attended with very little displacement or swelling. In fracture of the fibula low down, immediately above the external malleolus, there is very great displacement, at least

under certain circumstances. We may have fracture of the fibula about an inch and a half above the malleolar extremity, with very little displacement and with no eversion of the foot; but if, along with this fracture of the fibula, we have separation of the internal lateral ligament from its malleolar attachment, or if that ligament be torn to any extent, then we find that the displacement is considerable, the foot is turned round, and the sole looks outwards. This injury is called Pott's fracture and dislocation (plate xvii. figs. 9 and 10). It only occurs when the fracture of the fibula happens along with separation of the internal lateral ligament. The peronei muscles then meet with no resistance, and act on the foot so as to turn it outwards. The foot is, however, readily replaced, and the limb can be brought into accurate position; but we must take care to keep up the inversion of the foot, for the peronei muscles have always a tendency to turn it outwards, and so cause a falling-in of the upper end of the malleolar fragment of the fibula. If the internal malleolus be broken off and the external lateral ligament torn, the foot is inverted, though the displacement is not so great as in the former case, the displacing causes in this accident being the tibialis anticus and the flexor muscles passing behind the inner ankle. If we have the mere point of the external malleolus broken off, whilst there is no injury to the tibia, we sometimes have slight inversion of the foot. In fracture of the external malleolus, with laceration of the internal lateral ligament, the foot is displaced outwards. In fracture of the internal malleolus, with rupture of the external lateral ligament, the foot is displaced inwards.

The method of inverting and everting the foot, to keep the bones in position, is very simple. Pott used the simple lateral wooden splints, and these, with foot-pieces, keep the foot in very good position. Still there is a tendency to eversion of the foot, and therefore Dupuytren's splint is the one generally used for these fractures of the malleoli. This splint reaches from the knee to two inches or so beyond the ankle. It is padded with a sheet, which is folded double opposite the ankle, so as to form a soft fulcrum. Supposing the fibula to be broken, and eversion of the foot to have occurred, our object will be to invert the foot; the splint is therefore applied on the inner side of the leg, and kept fixed by slip-knots in the usual way (plate xvii. figs. 11 and 12). The part of the foot to be acted on is just above the projection of the fifth metatarsal bone, and we should act on the transverse arch of the foot, not on the heel. In this way we can see the position of the limb at once by looking at the foot. When there is inversion of the foot from fracture of the internal malleolus, and where therefore we want to evert the foot, we must apply the splint on the outside of the limb. When there is great separation of the bones of the foot, with retraction and inversion, we may use the stirrup splint, as already stated, by which the foot can be inverted and everted, just as with Dupuytren's splint, whilst retraction of the heel is prevented.

With exceptional instances, I have always employed these simple methods so long and successfully used in our hospital; and after very extensive experience in treating fractures in hospital, dispensary, and private practice, I see no reason for changing to other methods, which

certainly could not afford me better results, and which seem to me attended with some risk, from which these ordinary plans are free. I allude, particularly, to the use of the starch bandage and the plaster of Paris methods of treatment, which are now much used on the Continent. In regard to the dextrine or stucco bandage applied after the lapse of some weeks, when all risk of swelling or other results of the local irritation produced by the accident have passed away, and as a means of abridging the period of the patient's confinement, I not only have no objections to it, but have recourse to it very generally. But, used from the very first, I think it objectionable, as preventing the surgeon from observing the state of the limb, and guarding against mischief. The advantage which some claim for it, that the patient may walk about with a crutch in a day or two after the injury, I look upon as no advantage; but, on the contrary, I think the patient would be then much better in his bed, even supposing he felt the inclination to walk about. The plaster of Paris method, of course, has all the disadvantages of hiding the fractured limb from the surgeon's view; and, if I may judge from personal experience, when working with that material in taking casts, it must be anything but pleasant to the feelings of the patient when it contracts in setting. I have seen a considerable number of cases of fracture of the leg put up in this manner in Germany, and I can easily understand that many such cases do well enough; but it is quite as likely that in many cases the mass of stucco in which the fractured limb is embedded, may be, very literally, a whited sepulchre. In a word, I think when we possess well-tried, simple, and successful plans of treatment, we should be very chary in departing from them. Novelty is not always progress, and unfortunately many novelties in surgery at the present day seem to consist in departure from simplicity of treatment.

The Dislocations of the Ankle are two. One in which the bones of the leg are thrust forwards, while the foot is drawn backwards. The other, in which just the opposite displacement occurs, the bones of the leg being thrust backwards, and the foot drawn forwards. The former injury is the more common of the two. It very closely resembles fracture of the malleoli, with retraction of the foot; but on careful examination we find that the malleoli are entire, and the tibia and fibula unbroken, showing that there is no fracture, but simply dislocation with laceration of the ligamentous textures. A very great amount of force is required to cause this injury, and it is much more common to meet with the fracture than with the dislocation. When the injury does occur, however, it is easily enough recognised and treated, and it is less troublesome as regards the after-treatment than the fracture is.

When you are about to attempt to reduce the dislocation, put the patient under chloroform, so as thereby to get rid of the opposition of the gastrocnemius and soleus muscles. Then extend the foot, and counter-extend the bones of the leg, pushing them backwards at the same time if they are dislocated forwards. In this way the dislocation can generally be very easily reduced, and once reduced, there is little or no tendency to displacement recurring, for the malleoli, which retain the astragalus in position naturally, are kept on either side of it; but

to avoid risks, a bandage is put round the foot, and a splint placed either before or behind the limb, according to circumstances, and kept there for a short time. When the bones of the leg are thrust backwards upon the os calcis, there is sometimes a little more difficulty in reducing the dislocation than in the former case, where reduced retentive apparatus is applied to prevent displacement, as in the other dislocation.

In Compound Fractures and Dislocations about the Ankle.—I am convinced that, whilst we may occasionally obtain very good results, in the greater proportion of cases the results are so disastrous, that, as a rule, amputation is better than attempting to save the limb. In many cases the external injury is apparently very slight. The external wound may be small, and we may be able with very little force to replace the parts in position. Splints are applied, and the case may go on very well for a week or two, but then irritative fever sets in, with abscesses and erysipelatous action about the parts. Even in cases which ultimately do well, these bad symptoms come on, causing great risk to life. I have had five very successful cases of this injury in adults; but on looking back to those cases, and considering the dangers the patients ran, and the long time they took to get well, I have come to believe that as a general principle, it is safer to amputate the foot. I know that in many cases where I have attempted to save the limb under as favourable circumstances as in these five successful cases, the results were fatal. It is seldom that we can perform secondary amputation, on account of the fever and pyæmia which set in. Therefore, in the adult at or above middle life, in compound dislocations and fractures at the ankle joint, we should, as a rule, amputate rather than attempt to save the limb. But if we are to try conservative measures we must proceed on certain principles, and in children and young persons I would always endeavour to save the limb, unless in very scrofulous patients; but I would not be content with simply reducing the dislocation and keeping the parts in position. I would take care, if it was a small wound, to enlarge the opening, and remove the cartilage of incrustation from the surface of the tibia, from the internal surfaccs of the malleoli, and from the upper part of the astragalus. I would also remove any loose, torn portions of the synovial membrane, then bring the parts into position, so as to get the surfaces of bone into contact, and so make it rather a compound fracture than a compound dislocation. This is the plan I would rccommend, but in people above middle life I must say that my few successful cases recovered with so much danger to life that I would advise amputation rather than any attempt to save the limb.

Dislocation of the Astragalus sometimes happens from a person falling with great force upon the heel. The astragalus is thrust forwards, and completely dislocated from the other bones of the tarsus. At other times it is partially broken through, and in most cases it is almost impossible to reduce the bone—some, indeed, have declared it to be utterly impossible. In these cases I generally recommend that an incision should be made, and the loose bone be removed at once; but at the same time there are cases in which I have seen the bone reduced, and I would therefore always attempt reduction before making

an incision to remove the bone. There is a difference of opinion as to whether the bone, when irreducible, should be removed immediately, or whether a certain amount of inflammation should first be allowed to supervene. The advocates of the latter plan say that nature has altered the joint by this time, and the removal of the bone would therefore not be likely to set up irritation; but I think the best way is to remove the bone at once, provided that it cannot be reduced, and afterwards employ the ice treatment, which I would advise as giving a better chance of success than any other plan, especially in young subjects, where there is a very fair chance of a good recovery by this means. The astragalus may be thrown to the outer or inner side of the foot, and in a few cases we may effect reduction by extending the foot and pushing up the astragalus.

Dislocation of the Tarsus is not very common, but I have seen it occur, and I have also seen it reduced after it had existed for some ten or twelve weeks. This was done by dividing the tendons which prevented its reduction. A very useful limb was left. When the dislocation is recent the reduction is not a difficult matter.

Fracture of the Os Calcis is not an uncommon injury. It is caused by a person falling from a height with great force upon the foot. Sometimes the bone is simply broken across, or it may be split up and comminuted. In most cases the injury is a severe one, not only from the bone being broken up, but also because the very degree and kind of force causing the accident are likely to cause some injury of the head, so that there is generally concussion, and not unfrequently symptoms of fracture of the base of the cranium. We must, therefore, look to more than the local injury.

In some cases the tibia is split up, as well as the os calcis broken, and in most cases, even when the fracture is simple, necrosis with suppuration and great irritation follow, and amputation becomes necessary sooner or later. In one of my cases however, where the os calcis was much broken and comminuted, by keeping the patient at perfect rest for a time, a successful result was obtained without any suppuration occurring.

The ordinary plan of treatment is to keep the foot at a right angle with the leg, and apply a bandage from the foot upwards. Sometimes a pasteboard splint is placed along the sole of the foot. The limb is placed on a pillow, and the leg is very much flexed, so as to prevent the action of the gastrocnemius on the posterior part of the bone. If there be a great tendency for this portion of the bone to be dragged away, I would have little hesitation in dividing the tendo Achilles, as it would unite readily afterwards, and that is the only way to prevent the bone from being drawn backwards; but I have never met with this difficulty in my own practice.

The bones of the metatarsus are sometimes broken by direct violence, but they do not require any special treatment unless all of them are broken. If only one metatarsal bone is broken the others act as splints, and all the treatment required is to place a pad on the sole of the foot and apply a bandage.

CLINICAL CASES ILLUSTRATIVE OF THE SUBJECT OF FRACTURE AND DISLOCATION.

Case of Ununited Fracture of Humerus, cured by Modified Resection.

History.—On the 11th November 1852, A. Johnston, æt. 22, had his arm caught in a thrashing-mill, by which the humerus was broken at two points ; there was one fracture two inches below the surgical neck of the bone, and another at the junction of the middle and inferior thirds of the bone. He was seen by Mr. Falconer of Loanhead, who adjusted the fractures, and put up the limb in pasteboard splints. I saw him in the beginning of February 1853, at the request of Mr. Falconer, as the lower fracture had not united. On examining the arm I found the upper fracture firmly united ; the lower one, however, was quite movable, but there was no overlapping of the ends of the bone, nor any deformity when the limb hung by the side.

Treatment; Splints.—As the injury was comparatively recent, I advised a further trial of the splints, with pads, so as to keep the parts in accurate contact, the use of nutritious diet, and exercise in the open air. This plan was persisted in till the end of March 1853, when I again examined the arm. There was no attempt at union, and the ends of the bone were felt as if atrophied.

Subcutaneous Puncture.—I tried to excite action by introducing, by subcutaneous puncture, a strong sharp needle, or rather narrow knife, down to and between the ends of the bone, so as to break up the fibrous structure between them, and to scrape their surfaces. The splints were then carefully re-applied, and the arm firmly supported. At the end of six weeks I found that no change had been produced.

Seton.—In September 1853 I passed a seton between the ends of the bones, and retained it for some days, till suppuration occurred. Even this gave rise to very little local excitement, scarcely any inflammatory swelling supervening. What little there was passed off very quickly on the seton's being withdrawn, and no benefit resulted from its use.

Resection.—I had previously proposed resection of the ends of the bone, but at the same time thought it right to explain that it was attended with more risk than the methods hitherto adopted, and the young man's friends were at first opposed to its performance. After some months had passed, however, the patient was so anxious to give it a trial, that his friends consented, and I performed the operation in April 1854.

Operation.—I made a longitudinal incision on the outer side of the arm, about three inches in length, its centre corresponding to the seat of fracture. The arm was then bent at the false joint, so as to render prominent the ends of the bone, and the incision was carried down to them. I had determined to separate the bone as little as possible from the surrounding parts, and therefore merely cleared the lower end of the upper portion sufficiently to enable me to saw through about half its thickness, and I completed the section with a pair of strong bone-pliers. I then did the same to the end of the lower fragment, and snipped off some irregular portions. There was very little bleeding, and no vessel required ligature. The incision was closed with

four points of suture, dry lint applied, and the arm placed in a rectangular splint, so adjusted as to allow the wound to be dressed without moving the limb. No constitutional disturbance followed the operation; the pulse never rose above 80. The patient suffered almost no pain, and the wound united entirely by the first intention. Indeed, so little swelling or irritation appeared at first, that I was afraid this operation also would fail, but at the end of ten days there was firm limited swelling at the seat of fracture, and the patient stated that he felt the sensation of constant pricking pains in the part.

Result.—At the end of six weeks from the operation there was hard swelling, involving the ends of the fractured bone, and it seemed firmly consolidated. I therefore sent him home to the country, but directed him to keep on the splints for some time.

I subsequently saw him on several occasions, and I allowed him gradually to use the arm; but in November 1854, I found that, from using too much liberty with the arm, it had bent considerably at the united part, showing that it had not quite consolidated. I therefore fractured it fairly across, and re-adjusted it. This was attended with more pain and swelling than had yet occurred after any operation; but in two months afterwards, when I removed the splints, I found firm osseous union, and he can now use the arm with perfect freedom.

Commentary.—In reviewing the case just related, there are two points which, I think, deserve attention; first, the causes which originally prevented osseous union; and second, the plans of treatment adopted.

The causes, generally mentioned as leading to want of union in fractures, are either some state of the constitution debilitating the reparative powers, or some error in the treatment, such as mal-adjustment of the broken bones, too early movement of, or too much interference with, the injured limb. Occasionally, also, the interposition of some portion of muscular tissue between the ends of the fracture prevents firm union.

In this case there was nothing in the treatment which could have led to want of union; the parts had been well adjusted, and accurately retained in position, and there was neither shortening, overlapping of the ends of the bone, nor any other deformity when I first saw him.

As regards constitutional causes, he stated that his health was good; but he was rather pale, and suffered occasionally from dyspepsia, apparently depending on an inveterate habit of smoking; whilst the small amount of local or general excitement caused by any of the operations performed on the arm would argue a want of energy in the vital powers unfavourable to repair. Still, there was nothing so marked in the state of his general health as sufficiently to account for failure of union, and I think it is to the nature of the local injury in this case that we must look for the explanation.

It will be observed that the humerus was broken across at two points, and that the fracture was the result of direct violence of a kind likely to inflict great injury on the surrounding soft parts. The upper fracture united readily and completely, but the very consolidation at that part would diminish the free circulation through the medullary

Haversian structure, and, consequently, impair the vitality of the portion of the shaft between the two fractured points, whilst the bruising of the soft textures would be likely to impede the periosteal supply of nutrition, and thus the lower fracture would be placed in most unfavourable circumstances for union.

Secondly, as regards the treatment, the simpler measures at first adopted proved quite inefficacious, apparently producing scarcely any local excitement whatever. In deciding on resection of the ends of the fractured bone, I determined to remove no more than the rounded and atrophied ends, and to do so with as little disturbance of the parts immediately surrounding the bone as possible. Having often observed, in cases which had come under my notice, in which resection had failed, that fully two inches, or even more, had been removed, it always seemed to me, that not only the amount of bone thus removed, but also the great denudation required to effect its removal, was sufficient to account for the failure, besides increasing the risk of severe constitutional disturbance. Hence I adopted the plan described by which I was enabled, by using the bone-pliers, to complete the section without insulating the humerus, except the mere portion to be removed; whilst the bone so divided would more closely approach to the condition of fracture than if fairly divided by the saw.

The result fully answered my expectations, for there was scarcely a trace of constitutional irritation, whilst the incision healed by the first intention. At the same time, we must bear in mind that the patient seemed peculiarly unexcitable, as shown by the results of the former operation with the needle and seton. The osseous union was felt to be firm, but he had used the arm too soon and too freely, probably before complete ossification had taken place throughout its thickness, and so the bending had occurred. This, however, was scarcely to be regretted, for it led me to fracture it again to obviate deformity, after which the deposit of new bone was much greater than at first after the resection.

Case of Refracture of Femur for a badly united Fracture.

Thomas I—, æt. 24, unmarried, a farmer, residing in Ottawa, Canada, was admitted to ward xiii. S., on 8th October 1874, for badly united fracture of the femur.

History.—Twenty-one months ago, when up country, his thigh bone was broken by a tree falling upon it. It was three days before it was set, and then merely short splints were applied. He lay in bed for three months, but as the limb was never seen to after the setting, the bone united very badly.

On admission there was seen to be a marked deformity and shortening of the limb. It was four inches shorter than the right; while at the junction of the middle and lower thirds of the femur there was a great knee of bone projecting outwards, caused by the upper portion of bone riding on the lower. The knee was thrown outwards and forwards, the foot everted and unable, when patient was in upright position, to touch the ground. The muscles on the front and outside of the leg were paralysed, owing to the pressure of the bone on the external popliteal nerve.

Nov. 9.—The extension apparatus was applied shortly after admission, but

did little good. The tendo Achilles was divided, and the interrupted current applied to the paralysed muscles. The electro-contractility and sensibility were both found to be diminished in the injured leg.

March 30, 1875.—Since last entry little was done beyond the application of the interrupted current thrice a-week.

Fig. 61.

To-day, the patient having been placed under chloroform, Butcher's osteoclast was carefully adjusted to the limb, so that the pad lay over the projecting piece of bone. The instrument was then screwed home. A slight creak was heard during this, but as there appeared no sudden giving way of the bone, the sound was believed to proceed from the instrument. It was not until the screw was undone that the femur was found refractured obliquely, just where the union had taken place. Traction was now made on the limb, the long splint applied in the usual way, and well-padded Gooch's splints placed around the thigh to maintain the bones in position. The extension apparatus, weighted with 11 lbs., was also used to assist in keeping the lower fragment in its place.

April 2.—Pulse and temperature have been normal since the operation, except on that evening, when the temperature rose to 100°. Other 2 lbs. added to extension.

April 15.—The long splint and perineal band had to be removed ten days ago, as causing too much irritation. The extension weight has been gradually increased, so that now it amounts to 21 lbs. To-day the patient was put under chloroform, and forcible extension made on the limb, $\frac{1}{4}$ inch was thus gained, and the leg is now only $1\frac{7}{8}$ inch shorter than its fellow.

Fig. 61. Appearance of the limb in Mr. Spence's case of refracture of the femur—before and after treatment.

April 30.—Patient's general health continues, as it has been throughout, perfectly good. He complains of pain on pressure on the outer aspect, at the seat of fracture ; and, consequently, no further extension is to be attempted in the meantime.

June 6.—The extension apparatus (weighted with 15 lbs.) has been resumed for a time. Leg now $1\frac{1}{4}$ inch short.

June 26.—Patient allowed to get up.

July 15.—Sent to Convalescent House.

Aug. 2.—Readmitted.

Aug. 10.—Went home to Canada. Leg is quite straight, but the extensors of foot and peronei still paralysed.

Case of Fracture of the Neck of Scapula.

From Hospital Reports.

R. M., a man about forty years of age, applied for advice at the Royal Infirmary on the 17th of January, on account of an injury of the shoulder caused by his falling when in a state of intoxication.

On placing the hand upon the injured shoulder, before removal of his dress, there was no feeling of flattening, but on raising the arm slightly to take off his shirt to examine him more fully, the limb fell towards the axilla, causing a great projection of the acromion and flattening of the deltoid, with all the symptoms of luxation of the humerus downwards in an extreme degree, but attended with the distinct crepitus of fracture. By extending and drawing the arm out from the side and then raising the whole limb, the natural contour of the shoulder was restored, crepitus again being felt as the broken surfaces came into contact. When the support was even slightly removed from the elbow, the limb had the tendency to fall and be again displaced. Under these circumstances, Mr. Spence stated to the students present that the case was undoubtedly an example of that rare form of injury, fracture through the neck of the scapula, the separated glenoid cavity and the humerus being displaced together into the axilla, partly by the weight of the arm and partly by the great pectoral muscle, together with the latissimus dorsi, and teres major, drawing the arm towards the chest.

A pad was placed in the axilla, and the arm, slung by the elbow, bandaged to the side ; and as the man had also received an injury over the orbit, laying bare the bone, he was strongly advised to remain in hospital. This, however, he refused to do, but promised to return next day. Nothing more was heard of him till the 20th of January, when he returned and agreed to remain in hospital. During the interval which had elapsed he had been drinking, but the bandages had not been much disturbed. The apparatus was re-adjusted, the patient kept in bed, and warm-water dressing was applied to the wound over the orbit, which had begun to suppurate. Everything seemed to go on well for about ten days ; he suffered from no feverishness, and complained of no pain till the evening of the 1st of February, when he said his eyes felt painful. Warm-water dressing was applied over the eye and the orbital wound, and a purgative was given. Next morning he suddenly became insensible ; the wound looked dry, and its edges were erysipelatous. The erysipelas spread rapidly, and the semi-comatose state changed to violent delirium, under which the patient sank. The cause of death was meningitis, resulting from the injury of the frontal bone ; and a suppurative clot was found blocking up the longitudinal sinus. This unfortunate result gave an

opportunity of examining and determining the exact nature of the injury of the shoulder. The fracture was found to pass obliquely from below, upwards and forwards, commencing about $\frac{1}{4}$ of an inch behind the origin of the long head of the triceps, and separating the neck and almost the entire glenoid cavity from the scapula. The long head of the biceps and the whole of the glenoid ligament had also been torn from the upper remaining fragment of the glenoid cavity, and carried along with the displaced portion (plate xv. fig. 1).

Fracture of the neck of the scapula is admitted by all to be a very rare accident, and by many the possibility of its occurrence has been doubted. Mr. Pirrie mentions three cases where the symptoms were apparently well marked. Sir Astley Cooper also describes a case in which he was consulted; but, on the other hand, Mr. South, in his translation of Chelius's *Surgery*, states that there is no preparation illustrative of such an injury in any museum in London. One dissection of this injury by Duverney is, however, mentioned in Cooper's *Surgical Dictionary*.

The principal value of this case consists in the fact, that, by its fatal issue, a proof of the existence of such a fracture was established, and an opportunity was afforded for examining its exact anatomical nature, and the connection between it and the symptoms observed shortly after the occurrence of the accident. It should be noticed that the fracture did not pass from the scapular notch directly through the neck separating the glenoid cavity and coracoid process from the body of the scapula, as described by Sir A. Cooper, but obliquely through the neck, detaching nearly the entire glenoid cavity, the whole of the glenoid ligament, and the long tendon of the biceps, so that the articular structures were detached from the scapula, and were readily dragged downwards with the broken fragment by the weight of the limb and the muscular displacing causes.

Fracture of Neck of Humerus with Dislocation of Separated head into Axilla.

Case 1. While Mr. ——, a farmer was riding into town, his horse fell with him, and rolled on him. He recollected that in falling he threw out his arm to break the fall, and that his hand came in contact with the ground. He was brought to the hospital by a medical man shortly after the occurrence of the accident. The appearance of the shoulder left no doubt that dislocation had occurred, but there was also the distinct crepitus of fracture felt and heard on moving the humerus. On feeling for the head of the bone in the axilla it was found lying loose and detached, so that it could be grasped and moved readily, leaving no doubt as to its dislocation from the glenoid cavity and capsular ligament, and its separation by fracture from the shaft. Attempts were made by extension and coaptation to separate the shaft widely from the glenoid cavity, and by manipulation to press back the loose head of the bone into its place, but without success; and the patient refused to submit to further attempts at the time, and insisted on going home, so that I heard no more of him.

The nature of the accident was very distinct and palpable, and the history of the case shows, I think, very well, how this unusual accident occurs. In falling, the man threw out his arm instinctively to break the fall, and alighted with his whole weight upon his hand—the very way in which a dislocation at the shoulder was likely to occur ; and, whilst thus situated, his horse rolled over him, thus causing the fracture of the dislocated bone, for I cannot conceive of any kind of force which could cause luxation of the head and tuberosities of the humerus when broken off from the shaft.

Case 2. J. A. Fracture of the neck of the humerus, and dislocation of the separated head of the bone downwards into the axilla. The patient, who was fifty-three years of age, had, while cleaning a stair, slipped her foot, and, after falling with her whole weight on the right arm, rolled down the stair. She came to the hospital immediately after the accident, and then the right shoulder presented the usual appearances of dislocation downwards into the axilla. On further examination, however, there was found to be a fracture of the neck of the humerus, and on placing the hand in the axilla the head of the bone could be felt lying loose, and not moving along with the shaft in rotation. The patient was put under chloroform, and numerous unsuccessful efforts were made at reduction, but it was not until all attempts were about to be given up that the head of the bone was reduced, and then apparently spontaneously. A pad was placed in the axilla, and the ordinary retentive apparatus for fracture of the neck of the humerus applied. She made a good recovery.

As it is scarcely conceivable that both injuries could have occurred at the same time, it is probable that she dislocated her shoulder by the fall, and subsequently fractured the humerus while rolling down the stair.

LECTURE LIII.

INJURIES AND DISEASES OF MUSCLES AND TENDONS.

Rupture of Muscular Fibre—Causes—Symptoms—Prognosis—Treatment—Rupture of Muscular Fibre from Direct Injury—Division or Rupture of Tendons—Symptoms—Treatment—Rupture or Division of Tendo Achilles—Treatment—Deformities resulting from Alteration in Muscles and Tendons—Special Deformities and their Treatment—Strabismus or Squint—Wry-Neck—Contracted Tendons of Knee—Treatment.

As wounds of muscles have already been considered in the Lectures on Wounds, I shall now confine my remarks specially to Rupture of Muscular Fibre, and Rupture and Division of tendons.

Partial rupture of the fibres of a muscle is not an uncommon accident. For example, when a person unaccustomed to much exercise attempts some violent exertion or pedestrian feat, or when a person stumbles and makes a sudden effort to prevent himself from falling, he may rupture muscular fibres. The sensation is as if he had received a blow on the part, say the back of the leg, which is most commonly affected, and he walks lame at the time. After rest the part feels stiff, and the patient is unable to walk without great pain. In some cases we may notice a slight discoloration at the ruptured point, though not generally so, for it is usually the deep-seated fibres of the muscles which give way. Sometimes, however, we find an indentation at the part from the very first. In the latter case symptoms show clearly what has happened, and there is little difficulty in the diagnosis of these injuries, in any case, if we examine the limb. Where muscular fibre is partially ruptured, especially in the leg, we should examine very carefully the state of the whole limb, because not unfrequently the same symptoms indicate the first stage of popliteal aneurism. Therefore, even when the general symptoms indicate very clearly the true nature of the injury, it is absolutely essential to examine very carefully into the state of the whole limb, and not be satisfied with the mere history of the case, or with the account of the patient's feelings. If, on examination, we find it to be simply a case of rupture of muscular fibre, the treatment, to be successful, requires to be very careful at first. The prognosis is, that the patient will not walk well for some time, and that the limb will probably be stiff and lame for a year after the accident, but that he will ultimately gain perfect use of the limb.

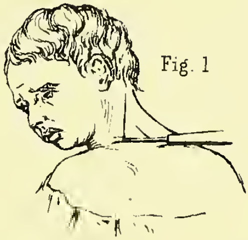


Fig. 1

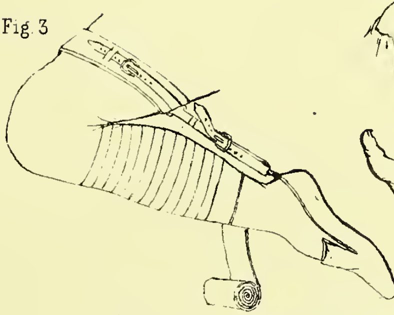


Fig. 3

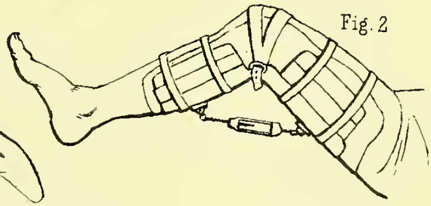
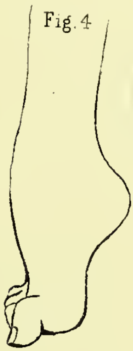


Fig. 2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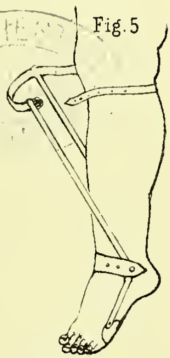


Fig. 5

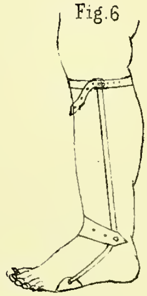


Fig. 6


Fig. 7


Fig. 8

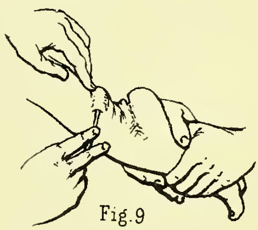


Fig. 9


Fig. 10


Fig. 11


Fig. 12


Fig 13


Fig. 14

Waterston & Son Edin. Lith

The best treatment at first is to keep the patient absolutely quiet, with the limb flexed, so as to relax the muscular fibres and allow them to heal by as short a uniting medium as possible, and so have the efficiency of the muscle fully restored. The shorter the uniting medium is the better. Whether in muscle or in tendon, this is invariably formed of fibrous, never of muscular texture. It is like a central tendon, and forms the line of connection in what has become a sort of digastric muscle. If this fibrous texture be short, then the muscular fibres attached to it on either side will act as well as before, but if we allow a long soft uniting medium to form with a large gap between the muscular fibres, we obtain a long central tendon, and the efficiency of the muscle is thereby impaired to a corresponding extent. Hence the necessity for keeping the limb at rest and the muscle relaxed in the first instance.

Tepid opiate or anodyne fomentations, followed by evaporating lotions, should be applied to the part to allay the pain, and to get rid of any effused blood. If there be great effusion of blood in the neighbourhood at the time, we should be very cautious about interfering with it by making incisions, even though there be fluctuation, because there is a risk of mistaking the fluidity of the effused blood for the fluctuation of suppuration. If we make incisions into the effused blood we are very likely to set up an unhealthy form of suppuration, while, by leaving it alone, it will disappear of itself, and therefore we should never interfere unless matter has begun to form.

Rupture of muscular fibre may occur from direct injury of the muscle, but here we must remember that other textures may also be affected from the nature and degree of the force. Gangrene may even result, in some cases, from extensive rupture of muscular fibre, even though the skin shows no symptom of injury, for the vessels lying in the neighbourhood of the muscle may be destroyed. A boy, lately under my care in the hospital, was struck by a planing-machine on the thigh, over Hunter's canal. There was an indentation containing fluid over the part, and there the femoral artery could be readily felt pulsating. The fibres of the sartorius were ruptured and retracted, the vessel was thus so far uncovered, that the feeling of pulsation was very distinct. At first I was afraid that the vessel was injured, but, on examining it with the stethoscope I found that the current of blood was quite natural; the extravasated blood must have been from small vessels. The case went on well, and the muscle united again by a shorter uniting medium than we can generally expect in the case of the sartorius muscle.

Division or Rupture of Tendons may occur in various ways. They may be wounded in any direction. Rupture of the attachments of the extensor muscles of the thigh, at or near the patella, or of the ligamentum patellæ, has been already treated of when speaking of the injuries of the patella. Not unfrequently we find the whole flexor tendons of the wrist divided by machinery or by a knife, and the extensors on the back of the hand also injured.

The treatment of such cases is just that of a simple wound, but we must take care to keep the limb in such a position that the ends of the

tendons may be as near together as possible, so as to get a short uniting medium. I have seen the whole of the flexor tendons at the wrist divided, and the lower end of the radius fairly cut through, yet the parts united, and a very useful hand was left. At the ankle I have also seen the extensor muscles and anterior tibial artery divided, and the tibia cut obliquely into the joint by a reaping-machine. The patient, an elderly woman, made a good recovery under the ice treatment.

INJURY of the TENDO ACHILLES is a common accident. It may occur from a cut, or the tendon may be ruptured by violent exercise. Not unfrequently it happens when a stout elderly gentleman indulges in dancing. There can be no difficulty in the diagnosis of the case if complete rupture has taken place. The patient falls suddenly to the ground, and we find the gap between the two ends of the tendon very apparent.

The treatment of the case is simple. A great deal of attention has been bestowed on this particular accident, though there is nothing very peculiar in it. The second Munro met with this injury. He very naturally paid special attention to the treatment of his own case, and afterwards published a memoir on the subject, which drew attention to the injury. In treating rupture of the tendo Achilles, the leg should be bent as much as possible, and a well-fitting sock or slipper placed on the foot. To the sole of the slipper we fix a piece of tape, which is brought up and buckled to a ring of bandage placed round the thigh, so as to flex the limb and relax the tendon, very much in the same way as in the treatment of popliteal aneurism by flexion (plate xx. fig. 3). We should also at first apply a roller, to prevent retraction of the gastrocnemius, and two lateral pads, so as to compress the tendon slightly on each side and prevent it from moving about, which it is otherwise apt to do. After five or six weeks, but not sooner, we may begin to relax the limb gradually. The patient must not be allowed to use the limb even then, because the uniting medium being still soft, if the foot were used it would be lengthened, and a good cure might thus be spoiled. We must wait till the uniting medium has acquired such a degree of firmness and solidity that it will not be likely to become stretched by use.

In some cases the tendon may not be completely ruptured at first, and the patient, though lame, may consider it a simple sprain, and walk about, and then some false step may complete the rupture. Under these circumstances the injury is apt to be neglected, and when a medical man is called in he finds that the tendon has so far healed by a very long and soft uniting medium, and the heel droops unsupported. Under these circumstances the treatment is to maintain the part at rest for a time in the position already indicated, and then to give support to the limb by proper apparatus. The simplest and best is an elastic and laced stocking, with a strong leather support in the position of the ruptured tendon, the leather gradually becoming thinner above and below, and extending from under the heel to the upper part of the calf of the leg. This support enables the patient to walk comfortably, and favours consolidation and contraction of the new uniting structure. When the tendo Achilles has been cut through, after clos-

ing the wound we treat the limb as in the former case, or we may pass a stitch or two of silver wire through the skin and the ends of the tendon, so as to keep them accurately in position. If the stitch cause any irritation it must be taken out. The rest of the wound is brought together by the ordinary suture.

The Deformities resulting from Morbid Contraction of Muscles and Tendons are either congenital or accidental—most generally the former, for injuries of tendons seldom cause permanent contraction if they be properly treated. The various forms of club-foot, and some forms of wry-neck and strabismus, are examples of deformity due to the permanent morbid contraction of muscular fibres.

The subject of deformity, arising from contraction of muscles, has always attracted considerable attention, and more especially in recent times since the treatment by subcutaneous section was introduced; so much so, that it now forms a sort of specialism or subdivision of surgery—Orthopedic Surgery.—Whilst I admit that the attention given to this department by gentlemen who have devoted themselves specially to the treatment of such deformities, has done much to improve our methods of treatment, I yet doubt whether the benefit derived from such specialisms is not more than counterbalanced by the tendency to make too much of the subject; moreover, it leads to the invention of highly ingenious but useless machines for rectifying deformities, to the exclusion of simple and more efficacious apparatus, and to promising too much in cases where little good can be expected, and where the apparatus often does harm. I fear, also, that they often lead to the proposal of operations or the application of apparatus where no such measures are required.

In this course of Lectures I shall confine myself to the consideration of those deformities which most frequently present themselves to the surgeon for treatment.

Before proceeding to speak of these special deformities, I would caution you that, whilst in general terms we speak of them as being due to contraction of muscles, you must always recollect that changes in other textures—such as shortening and thickening of ligaments, alterations in the forms of bones and of their articular facets and contractions of fasciæ and aponeuroses—are also very generally present, and require consideration in the operations for, and the after-treatment of such cases. In some cases the cause of deformity is not so much morbid contraction or shortening of one set muscles, as loss of power from paralysis in the opposing muscles. In other cases the muscular system may not be at fault at all. Thus, in some forms of wry-neck, the deformity results entirely from chronic disease of the ligamentous and osseous textures. And in many cases of strabismus the squint is not permanent, but evidently dependent on some nervous affection, or on some condition of the eye. Hence you will perceive the necessity of carefully examining cases before proposing operations or other treatment for their relief.

I shall now proceed to the subject of Special Deformities and their Treatment, commencing with strabismus or squint.

There are two forms of Squint, the converging and diverging. In

the former the globe of the eye is rotated or drawn in towards the inner canthus. In the latter the eye is turned outwards. In either case the squint may be modified by more or less obliquity, and this is specially noticeable in the converging squint, in which the eye is very generally directed upwards and inwards. The remote causes of strabismus are very various. The debility of vision, or of the muscles of the eyeball, resulting from infantile diseases, strumous inflammation, specks on the cornea, direct or indirect irritation of the brain and nervous system, may each and all give rise to squinting. In many cases we find that squint is not persistent, but is excited at times by mental emotions or disorders of the digestive organs.

When we examine into the state of the eye and its muscles in cases of persistent strabismus, to ascertain the proximate cause with a view to treatment, we meet with some in which, owing either to morbid shortening of one muscle or paralysis of its opponent, the eye is immovably fixed in the abnormal position, but these cases are comparatively rare. Most generally we find that when the sound eye is closed and covered, the strabismus disappears, the affected eye becoming straight. If we suddenly open the eye, which is usually straight, we will notice that it has been squinting whilst the other was straight. In many cases we have alternating strabismus, the squint being sometimes in one eye, sometimes in the opposite, or we may have double converging strabismus.

In regard to the treatment of squint, it is evident that it must depend on the cause. In many cases operative measures are contra-indicated—as, for example, in those where we have a peculiar rolling, restless motion of the eyeballs, and other symptoms of nervous excitability, or in those where the squint is not persistent. In many cases, also, by general treatment, and closing the sound eye, thus forcing the patient to use the affected one, the parallelism of the eyes is restored. But in other cases, if, after adopting this treatment, we find it ineffectual, and when we have reason to believe that the proximate cause is either morbid contraction of one muscle or paralysis of its opponent, then we may bring the parts into more natural condition by division of the contracted muscle. This constitutes what is termed the operation for strabismus. The muscles which require to be divided are, the internal rectus in cases of convergent squint, and the external rectus in the divergent form. Besides thorough division of the muscle, it will often be found that division of thickened bands of sub-conjunctival tissue requires to be made to free the eye, especially when the convergent squint is persistent and of long standing.

The operation is very simple and efficacious if properly performed. The only instruments required are a pair of finely-toothed, rather broad-pointed forceps, to raise the conjunctiva for division; a small blunt or probe-pointed hook of steel or german-silver, to slide under and raise the muscle; and a pair of ordinary straight scissors, blunted at the points. I used formerly to employ a very small sharp hook to fix the eye and draw it outwards; but it is really not necessary, and is liable to lacerate the conjunctiva. Suppose a case of convergent strabismus is to be operated on. The eyelids having been separated

and held by an assistant, whilst the opposite eye is closed, the operator desires the patient to look outwards, or if chloroform be used, the eye is drawn outwards by the forceps, and then the surgeon, raising a fold of the conjunctiva, makes an incision through it with his scissors about midway between the corneal margin and the inner canthus. In most cases, if his incision has been complete, the blunt hook can be readily passed back and beneath the internal rectus, so as to enable the surgeon to draw it forwards and divide it with the scissors. The muscle should be distinctly seen, and the surgeon should make sure that the whole is on the hook, for the muscle is broad, flat, and closely applied on the sclerotic, and a thin flat hook may perforate it and leave some fibres unraised. For this reason I prefer the probe-pointed steel hook of Græfe, as being less liable to injure either the muscle or the sclerotic coat of the eye. When the muscle is fairly cut, the patient is unable to invert the eye to any great extent. If any power of inversion remains, it is necessary to examine, lest fibres either of muscle or thickened sub-conjunctival tissue still require to be divided. Afterwards the conjunctiva is smoothed down, the eyelid closed, and a pledget of lint dipped in cold water is applied over the eye for some hours. Little or no after-treatment is necessary, unless any unwonted symptoms supervene.

In divergent squint the muscle to be divided lies in close relation to the ocular insertion of the inferior oblique, in fact overlaps it, and also the long branch of the third nerve supplying that muscle, so that more care is required in drawing forward the external rectus for division, to make sure of isolating it from the other structures. With the exception that the conjunctiva is divided between the corneal margin and outer angle of the eye, the steps of the operation are the same in both cases. When the operation for strabismus was first introduced here, I operated in a very large number of cases. Out of sixty cases on which I had operated from 1838 to 1843, I had only met with two cases of divergent strabismus, and in both of these the operation was perfectly successful. In some cases of convergent squint I have found it necessary to divide the internal recti of both eyes to secure a successful result.

In the operation, as originally performed, the incision of the conjunctiva was made in a vertical direction; but now I invariably make a horizontal incision, as the eye appears more natural afterwards, and the cicatrix is less. In divergent squint, however, I would still recommend the vertical incision, as giving more room, and enabling us to see the parts we are about to divide.

The cases of Wry-Neck in which the surgeon can relieve the deformity by myotomy are not very numerous. In the great majority the distortion arises from gradual chronic changes in the ligamentous, deep-seated muscular, and sometimes in the osseous texture of the vertebræ. In these cases operations would be useless or hurtful. In some cases, however, the deformity evidently depends on shortening or contraction of the sterno-mastoid muscle; and in these we can relieve the distortion by division of the muscle, or the part of it which is faulty. This condition is not always a congenital deformity, but may

arise from long-continued irritation, or chronic inflammation of the muscle and its fascial sheath; and I have operated successfully in adults well advanced in life.

The part of the sterno-mastoid which most usually requires division is the sternal attachment or inner head of the muscle. When the contraction is present, this portion seems narrowed, distinct, and prominent, so that you might suppose that a touch of the tenotomy-knife would sever it at once. In reality, however, there is greater breadth and thickness of muscular and tendinous texture than the appearance of the contraction would lead you to expect, and it is well to be prepared for this, for the part of the muscle to be divided lies in the neighbourhood of important structures. Large veins passing down to join the internal jugular lie close behind, and the great jugular itself is not far removed, so that it is important that, if possible, the whole resisting tissues be divided without having to re-enter the sharp-pointed knife after partial division. Indeed, when any resistent structure remains deep-seated, it is better to use a fine probe-pointed knife, introduced through the original wound. In some cases the contraction involves the fascial textures, which become thickened to a considerable depth. In operating in cases of this kind I have considered it safest to do so by exposing the parts to be divided by free incision instead of the subcutaneous method.

In performing the operation under ordinary circumstances, the head is placed so as to put the contracted portion of the sterno-mastoid on the stretch. The surgeon pinches up a fold of skin over the contracted muscle near its sternal origin, enters the tenotomy-knife, and glides its blade between the skin and muscle till it is fairly beyond the free edge of the sternal attachment. Then, turning the cutting edge towards the muscle, he divides it whilst an assistant keeps the head back (plate xx. fig. 1). When the contraction is fairly divided, a little pad of lint is placed over the part, and the position of the head maintained by means of a circlet of bandage round it, from which lateral bands pass to another circular bandage round the upper part of the chest, so as to enable the surgeon to keep the head back, and the face towards the side opposite to which it formerly looked. This is done by gradually tightening the lateral straps or bandages, so as to give the necessary inclination. In some cases both sterno-mastoids are contracted, and the head bent forward. In such cases both require to be divided; but in many of these, some of the other structural alterations alluded to are present, as well as contraction of the muscles, and then the operation does not much improve matters.

Division of Contracted Tendons at the Knee-joint is generally had recourse to as an accessory to other operations for contracted knee, such as the breaking up of anchylosis, or the excision of the knee where there is great contraction, to enable us to place the parts in good position. When required, the subcutaneous division of the tendons should always be the preliminary step in the operation, as their section is then more easily and surely accomplished. In dividing the outer hamstring muscle, the biceps, it should be divided near its fibular insertion, where it is narrowest; and in doing this, care must be taken

to avoid the peroneal division of the great sciatic nerve, which lies in close proximity. The mode of introducing the tenotome, and stretching the tendons to be divided, is similar to that advised in section of the sterno-mastoid. After division of these tendons, in cases of contracted knee-joint, the joint is gradually straightened by the screw-lever splint, represented in plate xx. fig. 2, or by means of extension by weight and pulley, the former gradually increased.

LECTURE LIV.

Club-Foot—Classification of the different Forms—Former Methods of Treatment—Subcutaneous Tenotomy—Necessity for After-Treatment by Apparatus—Talipes Equinus—Talipes Calcaneus—Talipes Varus and Talipes Valgus—Causes of Deformity, and Treatment of each.

THE various forms of CLUB-FOOT constitute the largest and most successful field for the practice of orthopedic surgery. In a course of lectures such as this I cannot enter into all the plans of treatment adopted, but will state, as succinctly as possible, the nature of the deformity, the general principles to be attended to in regard to treatment, and describe the methods of operating I have found most simple and effectual in my own practice.

Club-foot is usually classified under four primary forms:—1. Talipes Equinus; 2. Talipes Calcaneus; 3. Talipes Varus; and 4. Talipes Valgus. Other varieties, depending on the combination of the features of the primary forms, such as Talipes Equino-Varus, are mentioned, but in most cases of talipes varus the heel is drawn upwards as well as inwards.

The different varieties of club-foot used to be treated principally by various forms of mechanical apparatus, such as boots of different shapes. In some cases tenotomy was performed by cutting through the skin as well as the tendons. Subcutaneous tenotomy was introduced comparatively recently. This is a most important operation, for we can by it remove many kinds of deformity; we should not, however, trust entirely to the division of the tendons, which is merely a means to an end. There is, generally, some altered condition of the articulations and bones, as well as of the tendons, which requires to be remedied; and properly applied mechanical apparatus is therefore necessary if we wish a complete cure. In a case of talipes varus, for example, when we divide the tendons in fault we can bring the foot very nearly to its natural position at the time, without using any great force, but if we merely put the foot in a strong leather boot, and send the child away, telling its parents that nothing more is required, then probably the foot will be as bad as ever in a very short time. We must use means to keep the foot in the proper position, and keep the divided tendons far apart during the healing process, so as to get a *long* uniting medium. The contracted ligaments must be stretched, but this must be done gradually. If done at once, we expose the thin skin to a great deal of traction, which might probably cause it to ulcerate. We at first bandage, without stretching the parts very much

for a day or two, then put up the foot in a splint to keep it in its natural position, and afterwards apply a form of apparatus, the foot-piece of which is movable transversely, and which also keeps down the heel. In this way a permanent cure may be effected.

In some cases the club-foot is partly due to inversion of the whole limb, and then there is no use in dividing too many tendons; the eversion must be effected by other apparatus. Children are often brought to hospital for the cure of club-foot when only a few weeks old. It is, however, better not to operate so soon, for the bandages round the foot are constantly kept wet by the child's urine, notwithstanding the use of oil-silk or other protective measures, and the sore becomes irritable from this cause. Hence, though there is no risk in operating on very young children, I think it is better to delay doing so till the child is somewhat older.

Talipes Equinus (plate xx. fig. 4) is a form of club-foot where there is pointing of the foot arising from contraction of the gastrocnemius, soleus, and tendo Achilles. In a great many cases of simple talipes equinus, we find that the muscles of the anterior part of the limb are paralysed. The condition has arisen in childhood, either after infantile diseases, or from what is termed infantile paralysis. The anterior set of muscles having lost their power, there is nothing to counterbalance the action of the muscles of the calf, which then draw up the heel, and become increased in power as it were, the anterior muscles remaining almost unused. In such a case we must remember that if the anterior muscles be permanently paralysed, division of the tendo Achilles, though it will let down the heel and do good so far, yet will not be productive of much benefit as regards the use of the limb. On the other hand, if the anterior muscles have been only temporarily paralysed, by exercising these muscles we may make them come into action again, and so counterbalance the effect of the gastrocnemius and soleus, and then division of the tendo Achilles will be of permanent benefit. We should remember, in regard to the former class of cases, that we have a certain power of increasing muscular development, and also that muscular development does not depend altogether on nervous energy, for we can divide the nerve of supply to a muscle, and yet keep up its development to a great extent by means of galvanism. It is true that if the normal nervous energy be destroyed we cannot go on long keeping up the development of the muscle, but by using electro-galvanism along the course of a muscle we can do a great deal to restore its power. In many cases the nervous power has not been entirely lost, but has been in abeyance as it were, and we can then restore it. Hence, in talipes equinus, along with division of the tendon we should employ such means as galvanism, friction, and the tepid or cold douche, to restore the muscular power of the limb in front, and so equalise the muscular forces on the anterior and posterior aspects of the leg.

The operation for division of the tendo Achilles in talipes equinus is a very simple one.

An assistant holds the foot so as to press the heel upwards, and relax the tendon and the skin over it (plate xx. fig. 9). The surgeon

then pinches up a fold of skin over the tendon, glides the tenotome between the skin and tendon with the blade in a flat position, then turning the cutting edge towards the tendon, he desires the assistant to draw down the heel so as to render the tendon tense, and presses his knife against the resisting structure till he feels it snap and its ends retract. Should any fibres, however few, have escaped division, their section must be accomplished to render the operation completely effectual. Various forms of apparatus are used for gradually bringing the foot into its proper position, and maintaining it there; but the most efficient of these is the one represented in plate xx. figs. 5 and 6. The mode of action is obvious.

Talipes Calcaneus is an exceedingly rare deformity as a congenital condition. I have seen several cases arising from contraction after burns on the front of the leg and ankle, but I have never, in my own practice, met with it as a congenital deformity. This malformation consists in the foot being bent forwards at the ankle, and the heel pointed downwards and backwards, with a slight inversion of the foot. The tendons which seem to be in fault are chiefly the extensor of the great toe and the tibialis anticus, sometimes the common extensor of the toes. In many cases it will be found that there is either alteration in the gastrocnemius and soleus, or their common tendon, the tendo Achilles, which has permitted the extensors to give rise to the malposition of the foot.

The treatment consists in subcutaneous section of the tibialis anticus, the extensor of the great toe, and if necessary some of the contracted tendons of the common extensor. Then the foot is drawn back and the heel raised by using at first the simple apparatus recommended for divided or ruptured tendo Achilles, and subsequently using a special apparatus to prevent the tendons from uniting too soon or by too short a medium.

Talipes Varus is by far the most common form of club-foot. The foot is turned inwards, and the heel more or less elevated; the sole looking inwards and somewhat upwards, giving the whole foot a peculiar twisted appearance (plate xx. figs. 7 and 8). In general the foot is shortened or bent upon itself, owing to contraction of the plantar fascia. In cases where the deformity has existed for some time, and where the patient has walked, there is generally a large adventitious bursal formation on the outside to obviate the bad effects of pressure on the prominent part which rests on the ground. When you look attentively at a foot affected with talipes varus, you will observe that the principal deviation from the natural position is the turning in of the anterior part of the foot at the line of articulation of the os calcis with the cuboid, and of the astragalus with the scaphoid, that is, just in front of the ankle. The os calcis is drawn up to a certain extent, but not much if at all inverted. When the heel is very much drawn up the deformity is sometimes termed talipes equino-varus. The ligamentous textures on the outside are stretched and more expanded than natural, whilst those on the internal aspect are shortened

and thickened. In old cases these changes in the ligaments are very marked, and the forms of the tarsal bones are altered. Even in infants some slight deviations from the normal form of the bones exist, but not of a kind to give rise to any practical difficulties in the treatment. In the plantar fascia the most marked alteration is the contraction and thickening of the internal division of that structure. In its natural condition the internal portion of the fascia is thin and weak, as compared with the strong central portion; but in varus it is often almost, if not altogether, as resistent as the middle portion. The latter also is contracted so as to shorten the foot and arch the instep. The morbidly contracted muscles, which maintain the parts in this abnormal position, are the anterior and posterior tibial muscles; the gastrocnemius, soleus, and plantaris gracilis.

Division of the tendons of these muscles, together with the contracted resistent portions of the plantar aponeurosis, constitutes the operation for talipes varus, enabling us to apply an apparatus effectually. In regard to this operation, the surgeon must keep in view not merely the anatomy of the parts in their natural condition, but in the abnormal state in which he requires to operate. The alteration chiefly affects the position of the tendons. The bloodvessels are very slightly if at all displaced. The posterior tibial is somewhat relaxed from the altered position of the foot, and seems to curve slightly forwards above the inner ankle, and the great saphena vein is also occasionally somewhat displaced; but the surgeon can and ought always to ascertain the position of this latter vessel before operating. In regard to the tendons, the relations of the tibialis anticus are hardly altered, except that it is shortened and more tense than usual. The tendon of the tibialis posticus, on the contrary, is exceedingly altered in course and relation, owing to the altered position of the tarsus. This tendon, in a well-marked case of varus, passes almost straight, or with a very slight obliquity, down to its insertion at the internal cuneiform and base of the metatarsal bone of the great toe, instead of curving round below the internal maleolus, and then passing forwards as in the natural foot. A want of consideration of this altered state of parts has led to the proposal to divide the horizontal portion of the tendon in the foot as it passes forwards, so as to avoid risk to the tendon of the common flexor and the posterior tibial artery, instead of the usual plan of dividing it behind the lower part of the tibia. The tendon in varus, however, does not pass forwards, but almost directly downwards to reach its insertion, and hence the proposal is nugatory. The tendo Achilles, and the tendon of the plantaris gracilis, are shortened and distorted, so that they are not so well marked as usual, and the fascial textures around are thickened and often adherent to the tendon, so as to require division before the heel can be brought down.

Keeping in view these alterations in position and structure, it will be obvious that though the operation is in itself a simple one, it requires care and precision in its performance, so as to relieve the contracted parts, and care and observation in arranging and managing the mechanical apparatus subsequently, to complete the cure by proper after-treatment.

As to the mode of performing the operation.—It is generally laid down as a rule that the tendons of the tibialis anticus and posticus should be first divided before dividing the tendo Achilles. I can see no very good reason for this, because, when the tendo Achilles is divided, and the heel fairly brought down, we can, I think, judge better as to the division of the other tendons having been thoroughly effected, otherwise we may attribute any difficulty of everting the foot as partly due to the contracted tendo Achilles. In my own practice I have always divided the tendo Achilles as the first step of the operation, and I have never found any difficulty or bad consequences result from this. The division of the tendo Achilles is effected thus:—The assistant extends the foot so as to bend the heel towards the back part of the leg. The skin over the tendon being thus relaxed, the operator pinches up a fold of it immediately over the lower part of the tendon, glides his tenotome between the skin and tendon, then turns the cutting edge towards the tendon, and desires the assistant to stretch the heel. He then presses his knife till the section is completed, which is easily recognised by the sudden snap and the laxity of the heel (plate xx. fig. 9). In dividing the two tibial tendons we cannot easily pinch up the skin, and therefore put the foot on the stretch by trying to evert it. The tibialis anticus is thus made tense. The surgeon enters the tenotome over the inner side of the tendon, carefully avoiding the saphena vein, then passes the knife over the tendon, and cuts firmly upon it till he feels it separate. In dividing the tendon of the tibialis posticus I feel for the internal edge of the tibia, immediately above the malleolus, and holding the tenotome flat, and its edge directed downwards, I pass it in till I feel it project over the edge of the tibia, and then press it across the course of the tendon, altering the position of the blade so that the edge is turned towards the tendon and tibia, and the back towards the posterior tibial vessels. I then carry it, with a decided stroke, towards the bone, whilst the foot is everted, and in this way the tendon is thoroughly divided. I have already stated the reason why we cannot, in cases of varus, divide this tendon in the foot, as was once proposed. In every case the internal, and at least the inner part of the middle portion of the plantar fascia must be divided.

Having divided the tendons and fascia, and applied pads of lint and bandage, I seldom use any apparatus to stretch the foot for the first two days, or at most only a leather or gutta-percha splint. The second day after the operation I apply a strong leather splint, formed into a leg-piece and straight sole, and thus bring and maintain the foot more in its natural position, without overstretching the thin skin over the divided tendons. In two or three days after this I begin the use of the special apparatus, and that which I prefer is Stromeyer's, modified to suit particular cases. There is, however, one part of the apparatus which I consider of essential importance, and that is the formation of the sole of the foot-piece. This is very generally made of a single piece, so that whether we act on the foot by side-spring, screw-lever, or straps, the whole foot, including the heel, is acted on. Now, if we remember that the inversion is at the transverse articulation, between the os calcis and astragalus, with the cuboid and scaphoid bones, it is

evident that we can correct the deformity most efficiently by keeping the heel fixed in a straight position, and then everting the anterior part of the foot. For this reason the sole of the boot, or apparatus, ought always to be composed of two separate portions, as represented in plate xx. figs. 11 to 14, so as to allow us to act directly on the deformity. In other respects we require to watch each case, and modify our apparatus according to circumstances. I have frequently tried straps of vulcanised india-rubber instead of leather, but I confess I begin to suspect there is a fallacy in trusting to such elastic material; we can scarcely regulate them so well as less yielding straps.

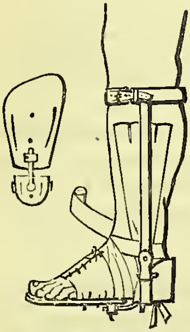


Fig. 62.

Of late years I have used a very simple but effective means of retaining the heel in close apposition with the apparatus. Strong adhesive plasters, of the same form as used for extension in cases of fracture of the leg, are applied from a little below the middle of the leg, and the tapes attached to the lower ends of these are passed through slits in the heel-piece, and fastened to a knob on its under surface, as represented in the woodcut. In this way all possibility of the heel being drawn up is prevented, whilst tight strapping or bandaging is rendered unnecessary.

Talipes Valgus is another form of club-foot. In it there is eversion of the foot. The foot is turned upwards and outwards, very much as it is in Pott's fracture; owing to the contraction of the peronei muscles (plate xx. fig. 10). The talipes valgus is, however, not nearly so common as the talipes varus, nor is it met with so often as a persistent condition, though it is not unfrequently met with in young girls as a hysterical condition. In such cases, by general constitutional treatment, and by rubbing the limb for a time with the hand, and moving the foot inwards, we find that the foot can gradually be replaced without any force. We rarely require to divide the tendons in talipes valgus, unless it be a persistent condition, and then the peronei are the muscles in fault, and the section of their tendons is very readily effected where they pass behind the malleolus externus.

LECTURE LV.

INJURIES AND DISEASES OF THE BLOODVESSELS.

Anatomical and Physiological Peculiarities of Bloodvessels—Veins—Wounds of Veins —Thrombus—Mode of healing in Wounded veins—Treatment of Venous Hæmorrhage—Diseases of Veins—Phlebitis—Symptoms—Pathological condition —Subacute or Fibrinous Phlebitis—Symptoms and Localisation—Abscess—Thrombus—Treatment of the different forms of Phlebitis.

THE peculiar anatomical characteristics of the veins and arteries must be considered in reference to wounds and diseases of these vessels, so that we may understand how their diseases arise, and what are the principles of the treatment to be adopted.

The coats of the veins differ from those of the arteries in two respects, first, in the want of the middle fibrous or muscular coat, which gives to the artery its roundness, contractility, and firmness, and to a certain extent its propelling power. Secondly, in the valvular arrangement of their lining membrane. The veins, however, have, like the arteries, a firm fibro-cellular external coat, and also a lining membrane, with intermediate connective areolar texture. In certain diseases we find that the areolar texture between the lining membrane and the external coat becomes very much thickened by effusion of plastic lymph, so that the venous coats, which are naturally very thin, become much firmer. A vein has not the uniform roundness of an artery, but is irregularly distensible, and on injecting it we notice irregular sac-like dilatations, caused by this unequal distension, and at certain parts are little nodulated points marking the position of the valves.

An artery has for its function the propulsion of the blood through the body, regularly and continuously, and so the interior of the vessel is smooth, and its canal uninterrupted by any inequalities, and even when any obstruction does occur, the collateral branches carry on the circulation. In the case of the veins it is different. There are a variety of hindrances to the return of the venous blood; we find that owing to different states of the viscera or muscles the free return of the blood is interfered with. Hence the veins require to have a power of distension, or of forming reservoirs for the accumulation of venous blood under certain circumstances. We find the sinus-like dilatation of veins allowed by a peculiar condition of their coats, and this condition has a great bearing upon the wounds of veins and the way in which they heal. Valves to support the returning column of blood are found in nearly all the systemic veins, but in the lower extremity they are much more

marked than elsewhere, for there they are most required. In the portal system of veins and in the hæmorrhoidal veins there are no valves; but even in the veins of the neck, where, owing to the direction of the blood-current, there is but little tendency to obstruction of the venous circulation, there are valves at different intervals, though there they are fewer and less marked than in the veins of the arm and leg—in which the returning column of blood requires mechanical support.

It is also necessary to trace the arrangement of the lining membrane with regard to the valves, in order to understand some of the diseases of veins. The lining membrane in veins is analogous to the same structure in the arteries—it is perfectly smooth, and lines the whole interior of the vessel. When we trace it to a valve we find no implantation of a structure like a valve upon the lining membrane, but the latter seems to project and form a duplicature, so as to make a valve. These valves are more or less complete. They project towards the centre of the vein, and when the column of blood has passed beyond them they are thrown back so as to close and support it. In the normal condition it is evident that the efficiency of these valves is important. Their competency will depend on the state of the lining membrane of the vein, and also upon any distension of the vessel; for the distension of the vein acts in two ways. A valve, which, in the normal condition is sufficient to close the vein, would become insufficient if the vein were distended, even if it were a valve implanted on the lining membrane. When, however, the vein is enlarged in calibre the lining membrane is drawn upon by the distension, and the valves formed by its projections are therefore diminished in size.

Keeping these facts in view, we shall now consider WOUNDS OF VEINS.—When a vein is wounded, the blood flows from it in an even stream, without any jerking or saltatory movement. The blood is of a dark colour, and the bleeding is in most cases easily arrested by pressure on the opening, or beyond it, on the distal side of the wound, or by the removal of any barrier to the venous circulation which may exist between the wounded point and the heart. Thus, in bleeding from the veins at the bend of the arm, all that is required to stop the bleeding is to remove the fillet round the upper arm and apply a compress and bandage.

If a vein be opened by an indirect wound under the skin it gives rise to effusion of blood into the loose cellular tissue around it, forming a tumour of greater or less size, called a *thrombus*, which is nothing more than a clot of blood. Such a tumour should never occur during or after venesection, for we should always choose a vein which is fixed, and the external opening in the skin should be of sufficient size to allow of the free escape of the blood. In cases of accident, however, or when a vein has been badly opened in bleeding, a thrombus may occur. Even if it does, no bad consequences will follow. If we close the opening in the vein, apply cold and evapouring lotions over the tumour, and keep the part quiet, the thrombus will gradually disappear. In opening a vein in the arm a thrombus may be formed, and if placed over the brachial artery it has been said that it might be mistaken for an

aneurism of that vessel, and so might lead to a serious mistake. But this is not very likely to happen.

There is one peculiarity of wounds of veins which I have frequently verified in experiments on animals—namely, that they heal principally from without. If we look at a vein which has been fairly cut across and tied, or which has been compressed, we find that it is pervious close down to the point where it was divided. Around the vein at the wounded point there is a quantity of lymph effused externally, but there is little or no tendency to change in the interior lining membrane. In a wounded artery we always find complete obliteration of the vessel at the injured point. The blood never circulates again through that part of an artery which has been wounded, whilst if a vein has been merely wounded and not fairly divided the circulation goes on through it as before. The small opening made closes externally by effusion of lymph, while the interior of the vein remains in its natural condition; so that in former days, when venesection was more common than it is now, a patient used to be bled several times from the same vein. This peculiarity arises in great measure from the sac-like distensibility of the vein, which allows it to be kept flaccid for a time, and afterwards allows the circulation to go on as perfectly as before. It is important to keep this in mind in reference to the radical cure of varix, for we may partly obliterate a vein, and yet the circulation may be re-established through it. In all cases of wounded veins there are two things to be done—first, to close the external opening by compress and bandage; and second, to favour the circulation returning towards the heart by attention to the position of the part, and by removing all articles of dress which might constrict the limb above the wound or ulcerated opening in the vein. If we leave any obstruction between the opening and the heart, hæmorrhage may recur from time to time and exhaust the patient.

The first of the DISEASES OF VEINS which we have to consider is PHLEBITIS, or INFLAMMATION OF VEINS. This is either *acute* and *diffuse*, or *subacute*, *circumscribed*, and *fibrinous*.[1]

ACUTE PHLEBITIS may arise in various ways from irritation of a wounded vein, as from punctured wounds in their vicinity, or from the application of a ligature to a vein, though my experience does not show that it is so likely to occur from this latter cause, especially if the vein has been cut across, as in amputation. There seems to be more chance of its occurring after ligature of a continuous vein. The symptoms of phlebitis are, first, pain in the part and tenderness along the course of the vein. Red lines are seen stretching up the limb, from inflammation of the veins and lymphatics. Then acute œdema and tension supervene, with a sort of erysipelatous redness over the whole limb. In some forms of phlebitis, instead of redness, the limb is preternaturally white, swollen, and glistening. These phenomena are accompanied by constitutional symptoms, rigors, a peculiar faintness, a tendency to yawning, and a feeling of præcordial weight and oppression. Occasionally there

is also some nausea, but this is not constant. There is not much headache at first, though it comes on secondarily.

If the phlebitis be less acute, the symptoms come on more slowly. If the vein be deep-seated there may be no redness, but the pulse rises. In all cases it is very rapid and irritable. The tongue is brown in the centre, and red and glazed at the edges, from the irritative fever accompanying the disease. The patient complains of what he calls rheumatic pains in some joint. The shoulder-joint generally becomes first affected, next the elbow, and then the wrist. The rigors become more frequent, and there is an increase of all the irritative symptoms. In some cases, preceding the affection of the joints, the patient complains of great pain towards the right side and back, and over the liver, while at other times there are in the early stage symptoms of pneumonia and of abscess taking place in the lung. These conditions depend, in the first instance, on the direction of the circulation through the vein. The inflammation extends along the lining membrane, though this is denied by some, who hold that the lining membrane of veins is not liable to inflammation. I think we have evidence of that action in the diffuse redness of the lining membrane of the veins affected, and in the thickening of their coats. We also find fibrinous deposits on the lining membrane of veins, and very often in the right side of the heart, in cases of phlebitis, more especially in cases where the symptoms proceed very rapidly to a fatal termination, with pain and oppression and dyspnœa. In other cases, where the progress of the disease is slower, we have affections of the joints. Wherever there is a large venous circulation, there venous congestion and effusion take place, irritation is set up, and circumscribed suppuration or secondary abscesses follow. Hence we meet with such abscesses most frequently in the liver, lungs, and in the interior of joints.

Fig. 63.

In Subacute, Circumscribed, or Fibrinous Phlebitis, the symptoms are not so severe or dangerous. The patient complains of great pain in the neighbourhood of the inflamed and swollen vein, and there is some constitutional disturbance. The pulse rises, but there is not so much fever as in the acute diffuse phlebitis, nor have we the articular affections taking place. These differences arise from the fact that in this form the disease has supervened on a chronic affection of the vein, giving rise to thickening and the deposition of a certain amount of fibrinous matter, and so blocking up the venous circulation (fig. 63). In many cases we even find abscesses forming in a vein, which we open just as we would any other abscess, without bad effects, and without a drop of blood escaping from the vessel, because the vein has been blocked up on both sides of the abscess by the fibrinous deposit, and thus the disease is localised. If, however, the disease be allowed to go on, and if the fibrinous deposit break up, owing to any freshly-excited action, then we have the acute diffuse phlebitis supervening on the chronic

form of the disease, and the symptoms may become ultimately quite as rapid and disastrous as in the originally diffuse form of the disease. In the chronic form the action is limited in extent, but if it break through the barrier of fibrinous deposit, it may spread along the coats of the vein, or, what is still more dangerous, portions of the fibrinous clot may be displaced, and give rise to thrombosis or embolism.

The best *Treatment* of Acute Phlebitis, in the first instance, is perfect rest, the application of leeches along the course of the inflamed vessel, and of acetate of lead and opium fomentations to the part. If it be a wounded vein, poultices should be applied over the wounded point. If there be any bogginesss or tension, free incision should be made. In the diffuse form of the disease we generally require to give stimulants very early to support the patient's strength. In the febrile stage, opiates must be given. Formerly calomel and opium used to be given; but this remedy would probably cause absorption of any plastic effusion which might have taken place, and so prevent the disease from being localised, hence it would be more likely to do harm than good. In cases where the patient is not plethoric, muriated tincture of iron, in 15 or 20 drop doses in water, every four hours, is often very beneficial. In a great many cases, however, in spite of remedies, the symptoms continue till the joint-affections come on. Secondary abscesses and pyæmia supervene, and a fatal issue occurs.

In fibrinous phlebitis the local treatment is like that of ordinary inflammation—leeching, punctures or incisions, and fomentations. If any abscesses form in the vein, open them without any hesitation; for, if you neglect to do so, the pus will break down the barrier surrounding it, and serious consequences will result from the passage of the purulent matter along the vein into the general circulation. After opening such abscesses in or over inflamed veins, the use of warm-water dressings, and support by the many-tailed bandage, and absolute rest, form the principal indications of treatment.

LECTURE LVI.

Varix—Nature and Causes—Pathological Alterations—Palliative and Radical Methods of Treatment—Obliteration by Ligature—Caustics—Subcutaneous Section and Acupressure—Hæmorrhage arising from Ulceration of Varicose Veins, and its Treatment—Abscess in Varicose Veins.

THE condition termed VARIX consists in dilatation of the veins, with impairment or destruction of the function of their valves, rendering them incompetent to support the column of blood. Other neighbouring veins become secondarily involved, till at last the limb affected with the varix has its veins distended and tortuous, and forming nodulated masses at different points. Between the tortuosities of the veins we generally meet with portions which are less affected or even healthy.

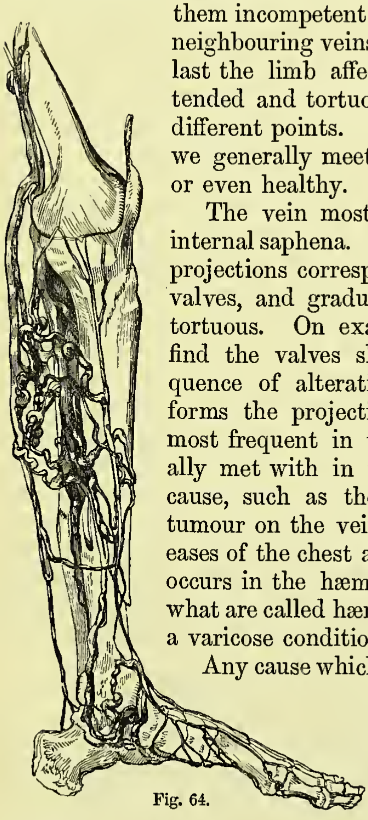


Fig. 64.

The vein most frequently affected with varix is the internal saphena. At first there is dilatation, and rounded projections corresponding to the position of its different valves, and gradually the vein becomes thickened and tortuous. On examining a vein in this condition, we find the valves shortened and thickened, as a consequence of alteration of the lining membrane, which forms the projecting portion of the valve. Varix is most frequent in the lower extremity, but is occasionally met with in the arm, arising from some peculiar cause, such as the pressure of an aneurism or other tumour on the veins of the arm, and also in some diseases of the chest and of the heart. The disease likewise occurs in the hæmorrhoidal veins, and then constitutes what are called hæmorrhoids or piles, which are originally a varicose condition of these veins.

Any cause which obstructs the returning venous circulation may lead to varix. It is stated to be more frequent in the left than in the right leg, because the sigmoid flexure of the colon is placed on that side, and is said to press upon the left iliac veins, and so to cause varix of the left leg. The truth is, that the disease is almost as common on the right side, and the cæcum, if distended, would press upon the right iliac veins just as much as the colon would on those of the left side. Tumours of

any kind may lead to varix. Tumours in the pelvis and in the abdomen, congestion or chronic affections of the liver, may conduce to varix, either in the form of piles or of varicose veins in the lower extremities. Affections of the heart and lungs may, as already stated, also lead to it. Hæmorrhoidal varix is very common as a result of interrupted pulmonary circulation. In the female, pregnancy is a frequent cause of varix, and the disease often becomes permanent from a want of attention to the state of the veins in the interval between different pregnancies. During the first pregnancy the venous circulation is interrupted, the vein becomes dilated, but not much altered in condition. The valves are rendered temporarily incompetent, but not to any great extent; and after confinement, the cause of the venous obstruction being removed, the vein returns to its normal state. If the incipient varicose condition of the vein be not attended to after the confinement and during subsequent pregnancies, it will probably give rise to much after-trouble. The venous coats will gradually become thickened, the valves will be rendered permanently incompetent, and the varicose condition then becomes of a chronic established character.

The disease has always a tendency to involve other veins. The blood passing through a vein affected with varix is no longer sufficiently supported, the weight of the column of blood presses downwards, and leads to further distension of the vein. But the blood must be returned to the heart, and therefore it is thrown upon the collateral branches. The deep-seated veins are less liable to distension, as they are subject to the action of the surrounding muscles, which assists in returning the blood towards the heart. The collateral superficial branches therefore principally enlarge, their cavities become distended, and their valves incompetent; and, indeed, the whole venous circulation of the limb is involved. The thickening of the coats of a varicose vein depends on chronic alteration taking place. When a vein is distended it always relieves itself at first by watery, and afterwards by more plastic effusion. This exudation through the coats of the vessel occasions a certain amount of irritation, whereby chronic inflammatory action is induced, and the coats become thickened in consequence. The interior of the vein is altered, inasmuch as the valves are rendered incompetent, and are in many cases almost effaced. The varicose condition of veins is a very serious affection, as it leads to effusion and chronic solid œdema of the affected limb, and to the formation of intractable ulcers. It thus interferes with the usefulness of the limb, besides involving the risk of phlebitis, and occasionally of dangerous hæmorrhage from ulceration of the varicose vein.

There are two methods of treatment adopted in varix; one is *Palliative*, the other *Radical.* The former has for its object the removal, as far as possible, of all causes which may tend to keep up or aggravate the diseased condition. This indication is fulfilled by attention to the state of the bowels and liver, by relieving the affections of the chest which may be present, and by enjoining rest in the recumbent position, so as to favour the return of the blood towards the heart. Our local treatment consists in bandaging from the foot or hand upwards, so as to give support to the superficial veins, and prevent any further en-

largement of them, thus causing the circulation to be carried on chiefly by the deeper veins, which are less likely to become varicose. Instead of bandaging the limb, we may use a thin silk or cotton stocking, with an elastic one over it. The latter must be well fitted from the ball of the toe to beyond the part where the diseased condition exists. The elastic stocking should be easy at the top, and rather tight below. By this means we give support to the veins, and enable the patient to move about without aggravating the disease. The elastic stocking, however, soon wears out, and a well-fitted laced stocking, though more expensive at first, is better, and perhaps as cheap in the end. The laced stocking should fit well, and should have small pieces of whalebone let in at different points, so as to prevent dragging and ensure an equable pressure. These form the principal palliative measures for ordinary superficial varix.

In varix affecting the deep-seated veins of the limb, where the femoral and saphena are both affected, and where there is a bulging at the upper part of the groin, great benefit has been sometimes obtained from the application of a small truss, with back lever-pressure, placed just over the saphenous opening, so as gently to compress the vein there. At first sight this has the appearance of interrupting the circulation, and might be thought likely to aggravate the disease. In such cases, however, we have to deal with a disease actually existing in which the valves have become incompetent, and where there is a column of blood above, which has a tendency to press downwards and increase distension. The truss prevents this gravitating tendency of the blood, and so does good. The use of the elastic or laced stocking should always be conjoined with the truss. The form of varix, however, in which the vein-truss is most useful, is that affecting the veins of the spermatic cord, termed cirsocele or varicocele. These veins are sometimes so distended as to resemble a hernia, though generally they have a tortuous, worm-like feeling. In some such cases we can completely arrest this condition in the earlier stages by the application of a proper truss placed over the inguinal ring. The truss is made to press upon the lower part of the canal, so as to prevent too much blood passing into the veins from above, but not sufficiently firm to prevent return of the blood upwards. This, along with an elastic suspensory bandage, produces very great benefit, and often saves the testicle from becoming atrophied. We must always remember that when we perform the radical operation on the veins of the cord, if we really obliterate all the principal veins there is a great risk of atrophy of the testicle taking place, even though the artery be left uninjured. The venous blood must be returned from the testicle; if it is not, then the arterial supply very soon becomes diminished in quantity, and so the gland becomes atrophied almost as much as if the artery itself had been obliterated. Division of the falciform edge of the fascia lata has been tried as a palliative remedy in varix of the saphena, but not with much success, nor is the practice likely to be followed.

The *Radical treatment* was at one time very much studied, and various plans have been proposed. Amongst the earlier methods was that of cutting down upon the vein and tying it, but phlebitis very

often resulted, and therefore ligature of the vein for the radical cure of varix was soon abandoned.

The next plan was to apply potassa fusa to the surface of the skin, over the affected vein, and leave it on till it made its way into the vein and caused obliteration of it. It was found that the caustic sometimes burned into the vein and caused hæmorrhage, and even when a clot formed, it was apt to break down and lead to secondary hæmorrhage, while in other cases extensive suppuration resulted, so that this plan also had to be given up.

Another method was to cut across the vein by subcutaneous section, without dividing the skin, and to place a pad of lint over the wound. Notwithstanding that the vein was completely divided, the circulation was sometimes restored through it; but in a few cases obliteration of the divided vein occurred, and a successful result was obtained.

The plan most generally adopted now is to obliterate the vein with a harelip-needle, by a form of acupressure. The vein-clamp, as it is called, was used at one time to compress the vein laterally, but now it is never used. In the radical cure at present adopted, the needle is introduced below the vein, and a thread applied round it, as in the

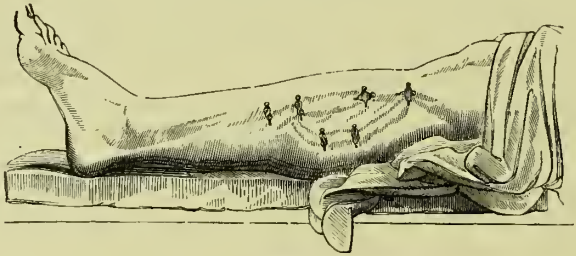


Fig. 65.

ordinary harelip-suture, so as to make mediate pressure on the venous coats, and not the direct pressure of the ligature, the skin being left between the needle and the vein, fig. 65. The needles are applied at the healthy parts of the vein between the tortuosities, and as many as six or twelve are inserted in the leg, so as to obliterate completely the canal of the vein. This plan answers very well on the whole, but I have not the same anticipations of a radical cure being obtained from it as I once had. It is a radical cure of the varix in the vein affected, but not of the varix of the limb. Should the needle be allowed to make its way out, or should it be removed after a few days? Formerly it used to be withdrawn after about three days, when the vein was felt to be firm and consolidated, but it was often found that the portions of the vein between the needles were still pervious, and continued so after the removal of the needles. I adopt, therefore, the plan of allowing the needle to ulcerate its way through, making sure that it is placed quite below the vein and not through it, so as to ensure that the circulation has been absolutely cut off, and the vein completely obliterated. Still I do not look upon this operation as really a radical cure for varix, because the venous circulation must be carried on, and

Fig. 65. Radical treatment of varix of the leg by needles and harelip suture.

the deep-seated veins alone cannot possibly accomplish this. Thus, when one superficial vein is obliterated, others become visible, and begin to enlarge, and then over-distension leads to valvular incompetency and varix in them. Whilst, however, we cannot radically cure the disease, we can do a great deal in this way to bring about a cure. We can get rid of the veins principally affected, and then, by using palliative means to support the circulation, we can prevent the collateral branches becoming so distended as to give rise to much inconvenience. That is all I can say for the radical cure of the disease. It is not a true radical cure, except as regards the vein originally affected; and varix is a disease which we cannot expect to cure radically, for we cannot obliterate all the veins of the limb.

Another plan has been lately proposed, viz., to inject into the affected vein, at different points, from half to one minim of pure carbolic acid. Before doing this, however, the part must be thoroughly constricted above, so as to prevent any clot being carried towards the heart. By this means coagulation of the blood and subsequent consolidation of the vein is produced, but I consider the needle to be attended by much less danger.

In cases of varicose ulcers, the first thing to do is to get rid as far as we can of the varicose condition of the veins of the limb: without doing this we cannot expect to cure the ulcer; and in such cases the radical method of obliterating the veins principally affected is of great value.

In some cases of varix we have to consider the question of hæmorrhage. Often at one point of the affected vein, a small, red, irritable spot appears on the skin, or in an ulcer over the vein, without much suppuration taking place. Without much warning this gives way, and when the patient is going about profuse hæmorrhage, of a very dangerous character, may take place suddenly. If the patient continue in the erect or semi-erect position, it may even prove fatal; because it is not merely the blood from below that is escaping, as in venesection, but the whole superimposed column of blood above the opening flows out, so that the right side of the heart is rapidly emptied, and fatal syncope ensues. The flow is rapid, both from the proximal and from the distal side of the opening. The treatment of such a case is very simple. Place the point of your finger on the bleeding orifice, lay the patient in the recumbent position, raise the limb a little, and apply a bandage from below upwards, over a compress placed on the bleeding point, and you at once arrest the hæmorrhage.

Sometimes abscesses form in or around a varicose vein. These must be opened freely, like any other abscess. In the fibrinous phlebitis the vein is blocked up both above and below the abscess, so that there is no danger of hæmorrhage when the abscess in the vein is opened.

In the radical cure for varix by the needles, it has been said that there is no risk of phlebitis supervening, but this is not strictly correct, for I have seen such cases. Whilst this operation is much freer from danger than any of the other methods of radical treatment, it is not absolutely without danger, for phlebitis does occasionally follow the operation.

LECTURE LVII.

Injuries and Diseases of Arteries—Their Anatomical and Physiological Peculiarities—Natural Hæmostatics—Torn or Twisted Arteries—Hæmostatic Process in such cases—Artificial Hæmostatics—Actual and Potential Cauteries and Styptics: their Mode of Action.

In speaking of the diseases of veins, I pointed out the necessity for bearing in mind their anatomical and physiological conditions. The same remarks apply with even greater force to the arterial system, in reference to the injuries and diseases to which it is liable, and to operations or other methods of treatment.

The points which I should wish briefly to recall to your minds on this subject are—1*st*. The structure of the arterial tube, and its function and source of nutrition. 2*d*. The cellular sheath of arteries, and its connection with the vessel. 3*d*. The peculiarities of the arterial circulation in reference to anastomosis.

For our present purpose, it will be sufficient to consider the artery as consisting of three tunics:—*a*. The internal serous or villous coat. *b*. The middle elastic fibrous or muscular coat. *c*. The external fibro-cellular coat.

The villous or serous coat presents a smooth free surface, and is covered with a slight moisture. Its smoothness favours the circulation of the blood through the artery. This lining membrane passes into the capillaries, and into every branch of the artery, and so long as it remains entire the circulation will in a great measure be uninterrupted. A very slight lesion, however, at any point of the lining membrane, will lead to an interruption of the circulation, and gradually to obliteration of the vessel at the injured point, or to the peculiar form of disease called aneurism. The internal coat of an artery possesses considerable vitality, and has a peculiar viscid or plastic secretion. It has, indeed, no direct vascular supply, but receives its nutrition from the middle coat, which itself is supplied from the external tunic, by the blood-plasma from the vessels ramifying in the fibro-cellular coat. The internal coat is so closely connected with the middle coat as to be almost inseparable from it, except in some of the larger vessels. If we

make traction on a vessel in the longitudinal direction, the internal coat does not yield because of its connection with the other coats, nor does it yield on transverse pressure ; but if we apply sharp and direct pressure on the external coat and across the direction of the artery, the internal and middle coats give way as if cut with a knife.

The muscular elastic or middle coat is that which gives to arteries their peculiar rounded form and elasticity, and it is met with in all the larger systemic vessels. It consists of yellow elastic or muscular fibre, arranged in circles, and is possessed of contractile power. An artery, when cut across, does not collapse like a vein, but remains with open mouth. This is due to the muscular coat, which gives firmness and resistance to the vessel, and serves, by reacting on the blood, as a means for carrying on the circulation, and preventing abnormal or irregular distension of the artery. If the *vis a tergo* were the only means of carrying on the circulation, the force of the blood would act more directly on some parts of the arterial system than on others, and the parts would yield, and distend irregularly. The muscular or elastic coat equalises the force of the circulation throughout the vessel, and so prevents any irregular distension, hence this coat is of very great importance. In regard to diseases of arteries it is important to remember this, for the above conditions actually do take place when this coat becomes affected. It sometimes happens that the middle coat of an artery, for the space of an inch or so, becomes altered, and loses its contractility and elasticity, and has no longer any power of reacting on the circulation. The vessel, however, above and below this part is quite normal, but at the diseased point it becomes distended, and forms an ovoid aneurismal pouch. The muscular coat has a great power of resistance as regards controlling the circulation, but it yields very readily to force, such as a ligature applied transversely; and also to great force applied longitudinally. Owing to the arrangement of the fibres, they are apt to separate from each other when such force is applied, and thus aneurisms are sometimes formed.

The external or fibro-cellular coat of the artery is very strong. Its fibres are arranged both obliquely and transversely, and offer resistance to force applied in any direction, by direct traction, by ligature, or by compression. It is the most resistant coat of the artery, both physically and as regards its vitality, and requires a great deal of force to break or tear it. As regards its vitality, we have seen that neither the middle nor internal coats have a direct vascular or nervous supply, but the external coat has both. The numerous vasa vasorum derived from the cellular tissue of the surrounding parts run upon and into this coat of the arteries, giving it a peculiar net-like appearance on the surface. On this direct nutritive supply, derived from the vessels of the sheath, depends the vitality of all the coats of the artery—the middle and internal tunics receiving their supply secondarily from the outer one. In operating on arteries, anything in our manipulations which interferes injuriously with these vasa vasorum will always do harm by impairing vitality, and cause a risk of rapid ulceration of the coats of the artery, and therefore a great risk of secondary hæmorrhage. Hence the reason why the surgeon should always be very careful not to disturb the con-

nections of the vessel with its cellular sheath, lest he destroy these nutrient vessels of the arterial coats.

The sheath of an artery consists of loose cellular tissue enclosing the vessel, and separating it from other textures. For example, we speak of a common sheath inclosing the carotid artery, the jugular vein, and the vagus nerve, but there is besides this a distinct septal sheath between the artery and the other structures, separating the artery from them. So it is with every artery. Each has a layer of fine condensed cellular tissue surrounding it, and having vascular connections with it and the surrounding tissues.

The function of the arteries is to distribute the blood over every part of the body, and nature has provided that if the circulation be interrupted at any one point, there shall be other branches to carry it on beyond the interruption. This constitutes what is called the collateral circulation. In the femoral artery, for example, there are certain branches coming off from the profunda which are termed the collateral branches, and which run in directions somewhat parallel to the superficial femoral. These communicate freely with each other, by oblique or transverse branches, termed anastomosing branches, so that when the main trunk is tied the circulation is still carried on. The term collateral was originally applied specially to branches running parallel to the main artery, but now the terms collateral and anastomosing are used almost synonymously. I have mentioned this anastomosis of arteries as a provision in case of interruption to the circulation at any point, but its effects in cases of wounded vessels must also be kept in mind. Thus, when an artery is wounded, the blood at first flows freely from the proximal side of the wound; and if the vessel be tied there, the flow of blood is re-established from the distal side of the wound, in consequence of the free collateral circulation and anastomosis.

When an artery is wounded, the bleeding takes place much more quickly from it than from a vein. If the opening in the artery be of any great size, the blood—of a bright red colour—flows per saltum and very profusely; and the effect produced upon the system is much more rapid as regards the faintness and sickness than in the case of a wounded vein. The character and form of the wound will modify the effects. If the opening be a slit parallel to the direction of the vessel, and across the course of the circular fibres, then if the limb be on the stretch, comparatively little bleeding takes place; but whenever the limb is relaxed, the bleeding becomes profuse, and this makes it difficult sometimes to find out where the wounded point is. On looking at a recent wound of this kind, when the limb is on the stretch, we cannot see any opening in the artery, but by relaxing the limb the bleeding takes place, and we can then

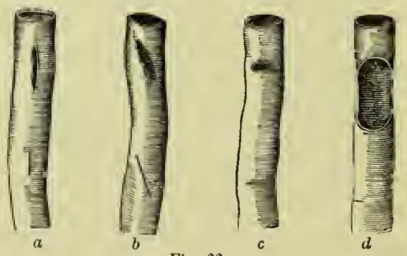
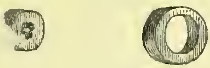


Fig. 66.

Fig. 66. Wounds of Arteries; (*a*), wound in long axis; (*b*), oblique wound; (*c*), small transverse wound; (*d*), transverse wound involving nearly the whole circumference of the artery.

discover the wounded point. If an artery has been wounded by a transverse incision, however small, the bleeding will be continuous and very profuse; for in this case the circular fibres of the arterial tube separate from each other, and the opening gapes. In oblique wounds of arteries there is an intermediate condition between what occurs in the longitudinal and transverse wounds.

In regard to HÆMOSTATICS, let us first observe the method by which nature arrests hæmorrhage from wounded arteries. When an artery is completely divided across, there is a tendency, from the elasticity of the coats of the vessel, for the artery to retract within the cellular tissue around it, and also for its circular fibres to contract concentrically, so that the vessel becomes diminished in calibre, whilst it also retracts within the cellular tissue. These are most important conditions in arterial hæmorrhage; for when a vessel is only partially divided this process cannot take place, and hence the natural hæmostatics are not so efficient in such a case as when the artery is completely divided. In some few instances of punctured wounds of arteries, when the bleeding is comparatively slight, a clot forms in the vessel, and the hæmorrhage is arrested, but the chances are much against the natural hæmostatic process proving efficient.



b Fig. 67. *a*

When an artery is wounded, the blood flows very rapidly at first, and produces an effect upon the brain and on the centre of the circulation, because, from the equal way in which the blood is distributed throughout the body, the brain soon feels the loss of its blood, and therefore a feeling of nausea and prostration follows. The force of the heart's action is diminished, then the blood begins to flow more slowly, and the hæmostatic process commences, so that the faintness may be considered as part of that process. In a completely divided artery the ends of the vessel retract within the loose cellular tissue in the neighbourhood, and within the loose cellular sheath surrounding the proper coats of the artery. A quantity of blood is thrown out into the cellular tissue, but at first, owing to the force of the circulation, it does not get time to settle there. As the faintness comes on, and the blood begins to flow more slowly, it collects in the cellular sheath and cellular tissue. Whilst this is taking place the coats of the artery proper have not only retracted, but have also contracted towards the centre, so that the orifice of the vessel is almost closed, the middle and inner coats contracting and retracting more than the outer. There is thus a mass of coagulum within the wound, and contraction of the cut end of the vessel, which prevent any further flow of blood, provided the current be not very strong. If it is, the clot may be thrust out from the end of the vessel, and the bleeding renewed. Under more favourable circumstances, the blood which passes through the vessel is obstructed in its course, and thrown upon the collateral circulation, which takes off a certain amount of the force of the circulation from the wounded point. The current of blood flows more slowly in the wounded artery. If the coats of the vessel be at all bruised, the blood soon ceases to

Fig. 67. Contraction of a cut artery shewn; (*a*), the orifice of a dead artery; (*b*), the orifice of a living vessel immediately after section.—Sir CHARLES BELL.

flow through it; the vessel no longer re-acts on the current of blood, and a clot is formed in its interior, as well as externally. This clot only extends for a short distance up the vessel—never beyond the nearest large collateral branch — and soon becomes consolidated, and forms a firm plug in the mouth of the artery, while the fibrinous mass outside has also become consolidated, and so no further bleeding takes place. But, if the wounded artery be of large size, this natural hæmostatic process is not likely to prove efficient in arresting the hæmorrhage.

Fig. 68.

Fig. 69.

In cases where a vessel is merely punctured the hæmorrhage ty be more troublesome, for then there is no retraction of the vessel If it be, however, a comparatively small vessel, the natural hæmost ic process will generally suffice to stop the bleeding permanently. The blood is thrown out, and a clot is formed at first in the loose cell ar tissue, and afterwards more directly between the cellular sheath of the artery and the coats of the vessel. This effused blood presses upon the artery, and so compresses its canal and diminishes or stops the current of blood passing through it. Sometimes the extravasated blood passes round the vessel, but generally it presses only on one surface of the vessel above and below the wounded point. In this way, if the clot consolidates, lymph is effused from the irritation and inflammation set up, and the part heals; but as the clot occupies the orifice of the wound and projects into the canal of the vessel, and as the coats cannot contract as when divided completely, the hæmostatic is less perfect. Sc

Fig. 68. Plan of natural hæmostatics in a cut artery. At *a*, the cut end of the arterial tube; conical, by contraction. At *b*, the arterial sheath, vacated by the retracted artery, and occupied by coagulated blood. At *c*, the coagulum projecting from the orifice of the sheath.—JONES.

Fig. 69. Plan of natural hæmostatics, in a cut artery. At *a*, the external coagulum; incorporated with the coagulum of the sheath, opposite *b*. There also the internal coagulum seen resting on the external; and extending upwards as far as the first collateral branch, at *c*.—JONES.

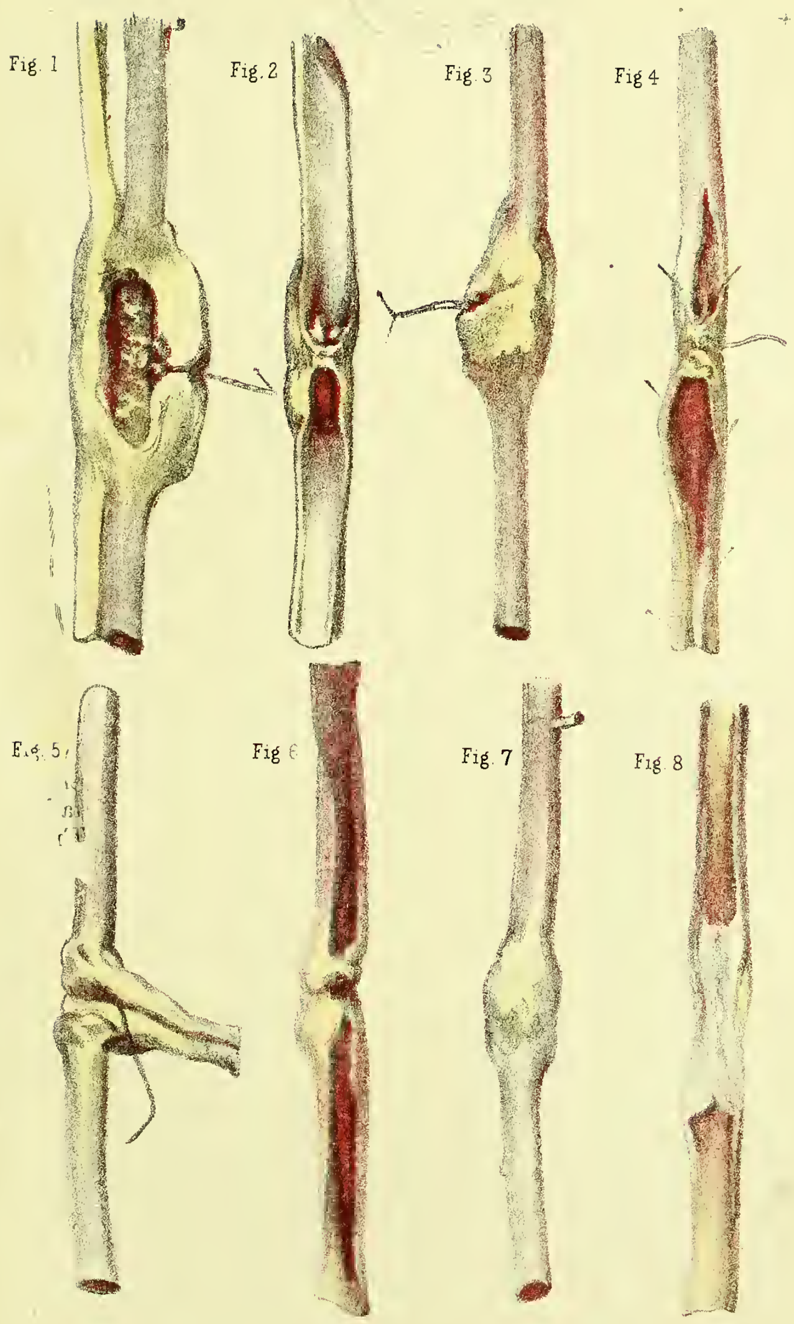


Fig. 1
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Clinical Cases at the end of the section *—Case of Mr. G——. In a large vessel, so soon as the circulation becomes strong again, on the occurrence of reaction, the clot which has formed will probably become displaced, and unless internal hæmostatic changes, from effusion of lymph and the formation of a clot within the artery, have taken place, secondary hæmorrhage will occur. It is important to remember this in treating

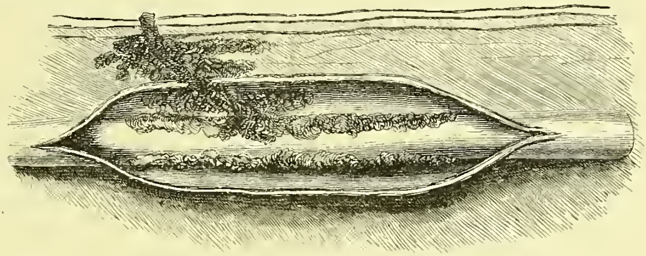


Fig. 70.

wounds of arteries. If we meet with a wound of a large artery, like the radial, pretty high up, and if the bleeding be completely arrested at the time by a clot over the end of the vessel, should we tie the artery above and below the wounded point, or trust to the natural hæmostatic process? My own opinion is that if the vessel be of a large size we should not trust to nature, but should at once secure it above and below. This is certainly the simplest and safest plan of treating such a case, for secondary hæmorrhage does sometimes occur after temporary arrest by a clot, and then the vessel requires to be tied under less favourable circumstances, as, owing to infiltration, the parts become very much matted together, making it difficult to distinguish or separate one texture from another.

Some surgical authors say that it is unnecessary to tie the vessel until consecutive hæmorrhage has occurred, but I do not approve of this plan. Two cases in my wards some years ago afforded good illustrations of the contrast between the two rules of practice. In one case the femoral artery was divided just where it becomes the popliteal, and a clot had formed in it, so that there was no bleeding at the time, but I did not trust to this, because I felt sure that when the patient became less faint and the circulation got stronger, the clot would probably be forced away, and secondary hæmorrhage would occur. I therefore adopted the safer plan, and tied the vessel, thus avoiding any risk. In another case, where the brachial had been wounded, and the bleeding temporarily arrested, repeated hæmorrhage necessitated an operation a fortnight after the injury, and the operation was very troublesome owing to the alteration and matting of structures. (See Clinical Cases.) *

Hence, in all cases of wounds of large arteries it is safer not to trust to the natural hæmostatic process, but rather to enlarge the wound a little, and tie the vessel above and below the wounded point. In wounds of small arteries, such as the radial low down, the natural process is generally sufficient to arrest the bleeding, but still, if we can

* Clinical Cases, vol. ii., after Ligature of Special Arteries.

Fig. 70. Natural hæmostatics in a punctured wound of an artery.

get at the vessel readily, it is better to tie it, for it is always unsafe to trust to the natural hæmostatic process.

When arteries are twisted, as in lacerated and contused wounds, we have a form of artificial hæmostatic—*Torsion.* The external coat of the artery is twisted and drawn out, whilst the internal coats are divided, retract, and are thrown towards the centre of its canal. The elasticity and vitality of all the coats are impaired for some little distance above the wound, so that the current of blood in the injured vessel is diminished or altogether arrested for some distance, and bleeding is prevented at the first (plate xxiii. fig. 6). In such cases there is a variety of circumstances favouring the formation of the clot and other parts of the hæmostatic process, and hence there is not much necessity for applying a ligature. When, however, as in injuries, the great vessels are twisted in this way, the case is generally one which, for other reasons, requires amputation.

ARTIFICIAL HÆMOSTATICS.—Having pointed out the methods by which nature arrests hæmorrhage from wounded vessels, I now proceed to consider artificial hæmostatics, one of the most important departments of surgery. The subject includes—(1) the temporary arrest of bleeding from a wound or during an operation; (2) the permanent closure of the wounded or divided vessels; and (3) the changes which take place in arteries tied in their continuity.

Temporary Hæmostatics.—The temporary arrest of bleeding may be effected by direct pressure with the point of the finger placed on the bleeding point, and a very moderate amount of pressure thus applied will suffice to arrest bleeding from the largest vessels, until other means be taken to control the circulation and secure the wounded vessel. Indirect digital compression of an artery between the heart and the wound will also effect the purpose, but in this case the pressure must be applied methodically by the surgeon himself, or a skilled assistant—otherwise it can hardly be trusted to. In some cases of emergency, as in wounds of the thigh, when the surgeon requires to look for and secure the wounded vessels, an assistant may keep up effectual compression on the femoral artery in the groin by means of a small door-key, the handle of which, wrapped in lint or rag, is applied over the vessel as it passes over the brim of the pelvis. I use a modification of this for compressing the sub-clavian in amputation or excision at the shoulder-joint, or in operations in the axilla. It consists of a narrow flattened piece of wood clothed with vulcanised india-rubber at its lower extremity, and terminating above in a full round handle. It answers the purpose very thoroughly.

In most cases, however, the circular compression by the tourniquet or india-rubber compressor gives more complete and certain command where it can be applied. In cases of accident a tourniquet may be improvised by using a pocket-handkerchief tied firmly round the limb above the bleeding part or wound, and then, by means of a stick used as a rack, it is twisted tight, and the stick secured to keep it in position. The ordinary tourniquet (Petit's) consists of two plates or platforms of metal, the one fixed, and the other moving from or towards it by means of a screw. Through the slits, between the rollers of the platforms, a

broad strong strap, with a buckle at one end, is passed, as represented in the woodcut. When the instrument is about to be applied, both platforms should be close together. A firmly rolled bandage is placed over the course of the main artery, and then the tourniquet is placed

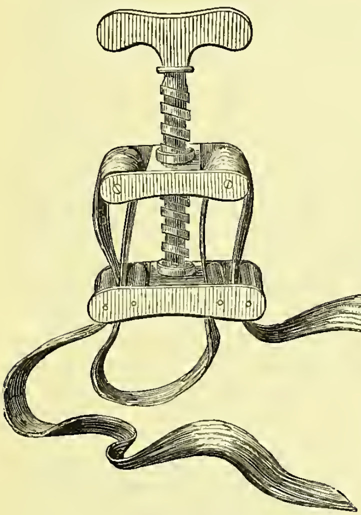


Fig. 71.

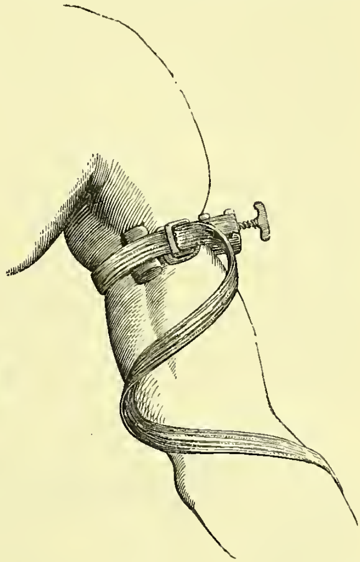


Fig. 72.

on the limb, the strap brought round and passed through the buckle, and the compression affected by tightening the screw, as shewn in fig. 72.

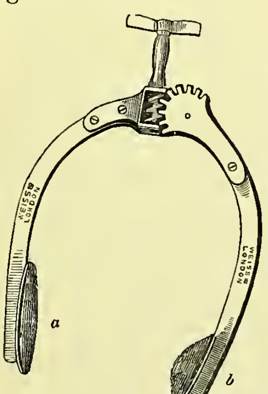


Fig. 73.

At one time an objection was made to the tourniquet, in as much as the circular band compressed the veins before the arterial current was controlled, and that in consequence great venous engorgement and unnecessary loss of blood occurred in amputations and other operations when it was used. To obviate this, tourniquets acting only on two points of the circumference of the limb, viz., over the main artery and the part opposite for counter-pressure were devised, such as Moore's and Signoroni's—the latter, a rack tourniquet, is shown in fig. 73. These modified tourniquets were not likely to save blood: for although venous congestion was in some measure obviated,

Fig. 71. The tourniquet, unapplied; but with its two platforms as much separated as if in actual use.

Fig. 72. The ordinary tourniquet shown in application to the brachial artery. A bandage enacting the part of compress over the vessel.

Fig. 73. Signoroni's compressor. *a*, The point of counterpressure; *b*, the pad which acts directly on the vessel.

the loss of arterial blood was greater, as there was nothing to compress the collateral branches on which, of course, the blood was directed as soon as the main trunk was compressed. Sir Charles Bell pointed out that by raising the limb, and applying a roller tightly from below upwards, to the place where the tourniquet was to be placed, before applying or tightening that instrument, and then screwing up the tourniquet at once, blood would actually be saved instead of being lost. Indeed, if the tourniquet be not tightened until the surgeon is ready to begin operation, and then rapidly and thoroughly screwed up, there will be but very little loss of blood.

The method employed by Professor Esmarch of Kiel, and termed "the bloodless method," consists in applying an elastic india-rubber bandage from the foot or hand upwards, for some distance above the part to be operated upon, so as to expel all the blood from it, then compressing the limb immediately above this, by means of a circle of strong india-rubber tubing twisted tightly several times around the limb, and fixing it, either by tying it or by the simple catch represented in the woodcut, which enables the surgeon to slacken the circular compressor at once when he wishes to do so.

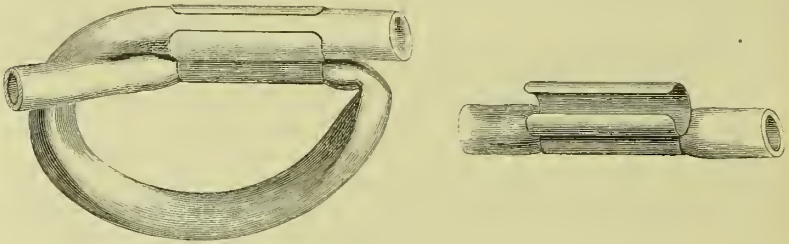


Fig. 74.

The method of Esmarch, though another example of a great improvement in carrying out a principle, can only be looked upon as a revival, not as new. The principle, it will be seen from what I have already said, was clearly enunciated by the late Sir Charles Bell; and the mode of carrying it out by bandaging the limb from below, and then rapidly screwing tight the tourniquet, is described when discussing the value of the tourniquet in amputations, in his *Great Operations of Surgery.* But it is not in amputation that the method is most useful or seen to most advantage; and hence it had generally fallen into disuse. The method of Esmarch, by using the india-rubber roller to expel the blood from the part of the limb to be operated on, and the strong india-rubber tubing to constrict the limb and act as compressor, effects the object in view perfectly, and hence enables us to see the parts on which we operate as in a dissection, and prevents all loss of blood during the operation. It is a most valuable assistance to us in such operations as those for necrosis and resections of bones and excisions of joints. In many cases of removal of large sequestra, or resections of the shaft of a bone especially, we can, by stuffing the wound with oiled lint, and applying a compress and bandaging the limb before removing the circular compressor, render the operation absolutely

bloodless. In excision of joints, where we require to tie arteries after the operation, I prefer the tourniquet to the india-rubber as a circular compressor. It is equally effective in restraining bleeding; and, by loosening or tightening the screw, the vessels can be secured with less loss of blood than when the india-rubber is employed. Indeed, in many amputations, whilst the incisions are completed bloodlessly by Esmarch's method, the sudden and general oozing from the cut surfaces which follows relaxation of the india-rubber entails more loss of blood eventually than when the tourniquet alone is used. I have repeatedly amputated at the thigh and at the hip-joint, using only the tourniquet or manual compression, with the loss of not more than three or four ounces of blood; and in one case of primary amputation of the hip in the country by candlelight, in which I had the blood carefully collected from the tiled floor, as there seemed to be a large clot, I found to my astonishment that it barely amounted to half a tea-cupful. In many cases of amputation, owing to the septic state of the tissues or the malignant nature of the disease for which we are operating, I consider it inadvisable to repress the blood and other fluids—such as unhealthy pus or cancer juices—into the parts above. In such cases I draw a band of india-rubber tubing, pressing on the limb from above downwards, and tighten it immediately above the part to be removed. This, of course, saves no blood to the patient; but it renders the operation bloodless in another sense, and is especially useful in private practice, as avoiding soiling of the floor or furniture. In cases of excisions of joints, where the parts are loaded with pus, I constrict above and below the point to be operated on, and thus secure a nearly bloodless operation without risk of repressing the unhealthy fluids into the textures higher up. I cannot see the advantage of the Esmarch method in such operations as ligature of the femoral artery. I have had frequent occasion to perform operations of that kind, and also of seeing them performed by others; but it is rare to see any bleeding; and I think it better that the artery and vein should be left in their natural condition, that the operator may see and deal with them. An empty and collapsed vein would, I think, run greater risk of being injured than when seen full in its natural relation to the artery. I make these exceptions, because I think that this form of bloodless surgery is liable to suffer from its indiscriminate use, and from over-laudation; but I have already said that I consider it a most valuable aid in proper cases, and it seems as if it were revived now with special relation to the progress of conservative surgery.

When digital compression is used for temporarily arresting the circulation through a large artery, it requires to be done very carefully and methodically, and I would advise attention to the following principles—(1), the part of the vessel to be compressed should lie over some fixed point of bone, which will not be affected by any movements of the part to be operated on; (2), we should choose a part near the surface, so as to avoid intervening textures, and render the pressure as direct as possible; (3), whilst the thumbs are applied over the vessel exactly, full compression should not be applied until the operator is about to make his deeper incisions. If this be not attended to, the compressing

thumbs will become tired and cramped by the time that pressure is most needed; in all cases the compression should be moderate.

Let us take digital compression of the femoral and brachial arteries as examples of the application of these principles. In the case of the former vessel the pressure should be exerted at the point where the artery lies on the ilio-pectineal eminence in passing over the brim of the pelvis. There the vessel is superficial, and we have fixed bone for counter-pressure which cannot be affected by any movement of the thigh. Moreover, the pressure being higher than the origin of the collateral branches, it fully commands the circulation. Compression of the femoral lower down in the upper part of Scarpa's triangle, is often recommended and figured in surgical works, but it can never be depended upon during an operation, for the vessel lies deep and rests on soft parts, which do not afford resistance for counterpressure, and hence the pressure requires to be very forcible to command the circulation, and consequently the fingers become soon tired. Moreover, any movement such as flexion of the thigh, is very apt to remove the vessel from beneath the finger. Compression of the brachial artery is made upon it along the inner margin of the biceps muscle by pressing the vessel against the humerus. I prefer compressing it high up, close to the lower border of the axilla, along the inner edge of the coraco-brachialis. Here the vessel is more fixed and less likely to be displaced from under the finger. At this point also we command the circulation better than lower down.

The point of election for compressing the subclavian is where that artery lies upon the first rib; but as it is very deeply situated, long continued pressure with the finger is exhausting, and the compressor which I have already mentioned is more easily applied and more to be depended upon.

Division of texture by means of apparatus, which prevents bleeding both at the time and permanently, requires mention, as methods of operating on this principle are again coming into practice. This form of bloodless surgery includes all cauterising agents, whether heated knives or galvano-cauteries, and all crushing divisors, such as the different forms of écraseur.

Before the discovery of the circulation no small ingenuity was used to invent instruments which would sear and arrest bleeding as they cut the textures; and some surgeons, when they ventured to cut through living textures used the summary method of applying hot pitch or tar over the face of the stump to arrest the bleeding. I am old enough to recollect seeing the result of an amputation of the thigh which had been thus treated. The man had been injured on board a whaling vessel; and, for lack of other aid, the ship's carpenter amputated. Whether from his acquaintance with ancient surgical authorities, or simply acting on the rules of his craft, he "paid" the stump with hot pitch. The man recovered well, possibly owing to the antiseptic action of the pitch, and subsequently eked out his means of living by exhibiting himself at the surgical classes as a connecting link with antique surgery. Although heated knives are again being used, I cannot and I do not think the profession will hail their revival as a mark of pro-

gress in surgery. But in regard to the use of the galvano-cautery for the purpose of dividing very vascular textures, or for removing tumours in situations where we cannot reach and tie divided vessels, or where there is danger from the blood entering the air-passages during an operation, as in some operations on the mouth, I think there can be but one opinion of the value of such means, and also that modern surgery has made advances, and I trust is destined to make farther advances in this direction. The chief difficulties to be overcome are in the cumbrous nature of the apparatus and the difficulty of getting a galvanic power in moderate compass to heat a platinum wire of sufficient thickness. In the surgical manipulations, habit of using the wire requires to be attained, to keep it in constant and close contact with the tissue to be divided, because, at any point where the wire does not touch and give off its heat to the tissue, it fuses and gives way under the action of the electric current. Those of us who have been accustomed to use the knife will find it advantageous to acquire the mode of manipulation necessary for proper use of the wire. From the very few opportunities I have had of seeing or using the galvano-cautery, I am hardly warranted in expressing an opinion ; but I think we require to modify the heat so as to divide the parts more slowly, because a large vessel cut across rapidly by a wire at a white heat will bleed at once as if cut by a knife. The écraseur is another means by which bloodless severance of textures can be effected, and it has even been employed for the amputation of limbs. Its real value, like that of the galvano-cautery, lies in its application to operations where the parts to be divided are so situated that we cannot tie the vessels or command bleeding during section of the parts. Its utility in such cases, more especially in operations on the uterus and tongue, has been longer and more largely tested than galvanic cauterisation, and, as compared with our present means of applying the last-named method, it is more simple and more easily managed; but it seems to me that, from the nature of the wound left after the use of the écraseur, it is more liable to unhealthy action than that resulting from the cautery; and if that method could be rendered more manageable, I believe it would gradually supersede the écraseur. Meanwhile, however, the écraseur is an instrument of great value for the class of cases to which I have alluded, and forms another addition to the resources of our art.

Artificial methods of arresting hæmorrhage by styptics, the actual or potential cautery, have all much the same action as the natural process—namely the formation of a clot and the prevention of bleeding for a time, allowing nature to bring about more permanent hæmostatic changes afterwards. The actual cautery should be applied at a red heat only, not at a white heat, lest the slough should separate too soon. It impairs slightly the vital functions of the coats of the vessel at the injured point, a clot forms, and the circulation is arrested. But these methods are all imperfect; they are apt to cause suppuration and sloughing, and so produce secondary hæmorrhage. Therefore, in all cases of wounds of arteries, the best plan is to tie the vessel above and below the wounded point with a couple of ligatures, or to employ acupressure by passing needles under the vessel. The reason for

using a double ligature is on account of the free anastomoses between the different arteries. If we only tie the vessel above the wounded point we partially arrest the bleeding for a time, but afterwards it comes on almost as profusely as before, by the retrograde circulation from the distal opening of the vessel.

When an artery has been fairly divided it should be seized with a pair of artery forceps (fig. 75), drawn gently out, and tied securely with

Fig. 75.

a ligature of carbolised catgut or dentist's silk, as represented in (fig. 76). In cases where the textures are so altered by disease that

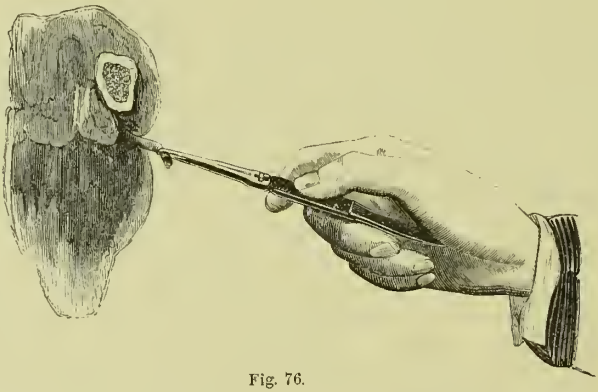


Fig. 76.

the vessel cannot be drawn out from them, or where its coats are so softened or brittle that they break down under the direct ligature, we use the tenaculum (fig. 77). Plunging its point deeply through

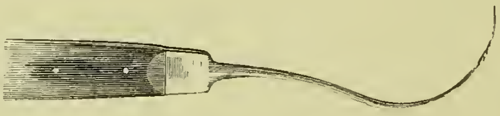


Fig. 77.

the tissues on one side of the bleeding point, we make it traverse the course of the vessel so as to transfix it, and then we bring it out on the other side. Drawing forward the tenaculum we next pass strong

Fig. 75. Artery forceps.
Fig. 76. Method of laying hold of an artery with the artery forceps and then tying it.
Fig. 77. Tenaculum.

silk thread beyond it, and tie it very firmly in a reef-knot, so as to constrict the wounded artery, and portion of the surrounding textures (fig. 78).

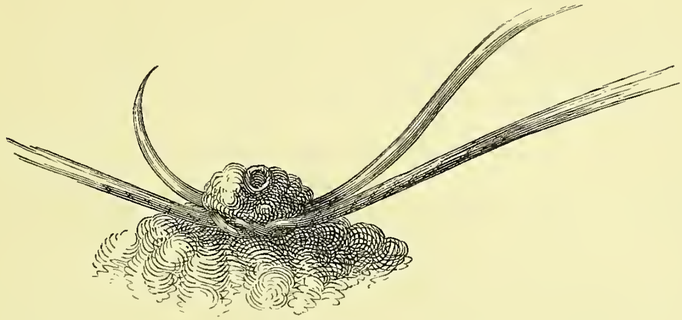


Fig. 78.

Fig. 78. Method of securing a vessel by means of the tenaculum.

LECTURE LVIII.

Artificial Hæmostatics—Historical Sketch and Review of the Principal Opinions which have been held regarding the Ligature of Arteries.

In my last Lecture I spoke of wounded and torn arteries, and explained the processes by which nature arrests bleeding in such cases, constituting what is termed natural hæmostatics. I also alluded briefly to certain means used by the surgeon to arrest bleeding from wounded arteries.

The subject of Artificial Hæmostatics is one of the most important in surgery, and requires to be very fully brought before you. The use and effects of the ligature as the means most commonly adopted hitherto for arresting hæmorrhage, and still most generally practised, come first to be considered, and it will be well that I commence by giving you a historical sketch of the principal opinions which have been held regarding the essentials to the obliteration of an artery by ligature. I believe that a knowledge of the previous history of such investigations is absolutely necessary for their further successful prosecution, and this is too much neglected in the present day. In many departments of surgery there is a constant tendency of circumstances to revive, with slight modifications, doctrines and practice formerly inculcated, but which had been abandoned as imperfect or bad. Now, a knowledge of the history of the subject, by showing what were the comparative advantages and imperfections of such exploded doctrines and practice, and how far the objections which had formerly led to their disuse were well founded or the reverse, or how far these could be met by certain modifications, would do much to prevent the revival of what had on good grounds been abandoned as dangerous or useless. Such knowledge may, on the other hand, serve to point out the causes of former failures and the means of obviating them, and so re-establish the practice on firm grounds.

The Ligature, as a means of arresting hæmorrhage or for the cure of aneurism, seems to have been used from a very early period in the history of medicine, although the ancients who mention the practice appear to have been guided by no distinct principle in its application. Indeed their ignorance regarding the circulating system generally must have prevented their arriving at any correct principle. But that it was used by them as a means of arresting hæmorrhage long previously to the times of Paré is incontestable. Celsus speaks of the ligature of wounded veins, Galen directs it to be used for wounded arteries; whilst

Ætius and Paulus Egineta give directions for cutting down upon and tying arteries in cases of aneurism.

It is undoubtedly to Ambrose Paré, however, that we are indebted for reviving the practice of tying arteries—which had fallen into disuse—but even he seems to have directed little of his attention to the principle of its action, beyond its evident mechanical agency in preventing the flow of blood at the time of its application. This is scarcely to be wondered at, when we consider that the cases in which he used it were generally those of amputation or of recently wounded arteries, and as in such cases secondary hæmorrhage would be very rare, the new agent would appear so evidently superior to the wretched contrivances formerly used that he would simply rest satisfied with its practical utility, without caring to investigate its *modus operandi.* When, however, the ligature came into more general use, and more especially when it came to be used in cases of aneurism, the secondary hæmorrhage which occasionally followed its application caused his more scientific successors to direct their attention to the subject.

M. Petit seems to have been amongst the first of those who proceeded to investigate the question of the arrestment of hæmorrhage experimentally. The results of his experiments were communicated to the French Academy. He attempted to prove that the essential agent in arresting hæmorrhage was the coagulum within the artery acting as a firm plug, and that this was the case by whatever means the bleeding was staunched, whether by cauteries, styptics, compression, or ligature. That the greater security of the last-mentioned agent over cauteries and styptics consisted in the form of the clot and the greater certainty of its formation. He concluded that, properly applied, compression was preferable to all other means as giving the best form of coagulum, and so preventing secondary hæmorrhage. In support of his views, he brought forward portions of arteries after amputation, exhibiting the clots formed in them; and by other experiments regarding styptics, he tried to prove that they acted by absorbing the moist portions of the blood, and leaving a solid coagulum. Young, from expressions in his work *On the virtues of turpentine as a styptic,* seems to have the same views regarding the coagulum being the essential cause of obliteration. A similar notion was entertained by Morand, who, however, thought the action was assisted by a peculiar contraction or corrugation of the vessel. M. Pouteau objected to Petit's views, and attributed the arrestment of hæmorrhage entirely to the condensation of the parts around the end of the vessel at the point tied. He says "I have dissected a femoral artery three weeks after it had been tied in amputation, but in it I found nothing of M. Petit's clot; nothing to close or compress the artery, except merely the thickening of the surrounding cellular substance, for the ligature was loose about the artery, the canal was conical, for it grew narrow near the ligature."

This fact, noticed by Pouteau, was of great importance, as we shall afterwards show, had he only more carefully examined the nature of the condensation round the vessel. But, unfortunately, he considered it as furnished by the surrounding parts included with the vessel in the ligature, and this led him to the very dangerous conclusion that the

more of the soft parts included in the ligature the better chance would there be of safe obliteration. White, Kirkland, and Aitken, at first inclined to believe in the doctrine advanced by Pouteau, ultimately ascribed the arrestment of the blood and the obliteration of the vessel, even up to the collateral branches, to simple contraction of the diameter of the vessel; according to Mr. Kirkland, "nature suppresses hæmorrhages from divided arteries by the natural contraction of their muscular fibres."

Mr. John Bell, in his explanation of the action of the ligature, in the first volume of his *Principles of Surgery*, published in 1801, says:—"This process, then, may be explained in a few words: the ligatures applied round an artery operate by making the several points of the arterial canal pass through the several stages of inflammation, from adhesion in one point to gangrene in another." "The space included betwixt the ligatures" (he is describing the ligature of the brachial above and below the wounded point) "falls into gangrene; the space immediately under the structure of each ligature adheres. This adhesion prevents the gangrene or the inflammation passing along the higher parts of the arterial canal; but the inflammation affects the arterial tube a little way upwards and downwards, so as to thicken its walls and contract its cavity, whence the canal of the artery is obliterated a little way beyond the exact place where it is tied."

"That arteries never bleed from the flat surface of an amputated stump, is a still more decisive proof of this doctrine; we pull out those with the tenaculum and forceps, tie them with a small thread, and pull that thread away by the third or fourth day (!). No one will suppose, when the ligature is drawn away, that such an artery is prevented from bleeding by a clot stopping the mouth of the artery, as M. Petit imagined; nor that the canal of the artery is compressed by the inflammation and thickening of the surrounding cellular substance, as alleged by M. Pouteau; for we draw out the artery, and tie it quite clear of any cellular substance, or muscle, or adjacent nerve." "The artery, when tied thus, can be obliterated *only by adhesion of its internal surfaces;* the part directly under the compression of the ligature unites by adhesion; the part below the ligature is destroyed like a polypus, fades and dies; and it is the fading of the lower part thus mortified that allows the noose of the ligature to slip off on the third or fourth day."

From what has been said, it will be seen that even so late as 1800 the effects of the application of the ligature on an artery were not very distinctly or fully known. A great deal was conjectured or reasoned on from analogy; and even of those who had founded their reasoning on experiment and examination of vessels which had been tied, whilst each of their theories contained, as we shall find, a certain amount of truth, all the investigators were led to conclusions more or less erroneous from over-estimating some one point of the process as *the essential;* and apparently considering it necessary to prove this, by showing that those parts of it which had been noticed by others were of little value. The beautiful plan of operation for aneurism, proposed by Hunter in 1785, which was now coming into general use, and the occasional occurrence of secondary hæmorrhage which in some cases

followed its performance, gave an impetus to the further investigation of the effects of the ligature.

In 1805, Dr. Jones published the results of an extended and carefully conducted series of experiments; and his deductions, with very slight modification, constitute the opinions of the present day, except with those who advocate the use of the broad ligature. It had been shown by Desault and Bichat that an artery tied with a ligature always exhibited a division, or, as some termed it, a laceration, of its internal coats. This fact, pointed out to Dr. Jones by the late Professor John Thomson of Edinburgh, led him to investigate the subject by a series of experiments. The effects of the application of the ligature which he noticed, are given by him as follows:—*1st*, "To cut through the middle and internal coats of the artery; and to bring the wounded surfaces in close apposition." *2d*, "To occasion a determination of blood on the collateral branches." *3d*, "To allow of the formation of a coagulum of blood just within the artery, provided a collateral branch is not very near the ligature." *4th*, "To excite inflammation on the internal and middle coats of the artery by having cut them through, and consequently to give rise to an effusion of lymph, by which the wounded surfaces are united and the canal is rendered impervious; to produce a simultaneous inflammation on the corresponding external surface of the artery, by which it becomes very much thickened with effused lymph; and at the same time, from the exposure and inevitable wounding of the surrounding parts, to occasion inflammation in them, and an effusion of lymph, which covers the artery and forms the surface of the wound." *5th*, "To produce ulceration in the part of the artery around which the ligature is immediately applied—namely, its external coat." *6th*, "To produce indirectly a complete obliteration, not only of the canal of the artery, but of the artery itself to the collateral branches on both sides of the part which has been tied." *7th*, "To give rise to an enlargement of the collateral branches."

The parts of the process which Dr. Jones principally insisted on as essential to obliteration of an artery without secondary hæmorrhage occurring, were—*1st*, The effusion of lymph within the vessel, caused by the degree of inflammation consequent on division of its internal coats, and the subsequent adhesion of their cut surfaces or cicatrisation of the cut made by the ligature. *2d*, As subsidiary to and favouring this process, the least possible interference with the connections of the artery to its sheath, lest we injure its nutrient vessels, which pass from the sheath to the coats of the vessel. The effusion of lymph around the vessel, and the presence of a coagulum within it, he appears to consider as merely incidental circumstances. The former, he considers, may compensate in some measure in cases where the vessel has been tied with a single ligature, as for aneurism, for the advantage of retraction of the ends of a divided artery into the surrounding cellular tissue. But he does not seem to consider it as holding any very distinct place in the process of obliteration. He objects to broad ligatures, and foreign substances introduced between the ligature and the vessel, as not causing adhesion, but giving rise to slow ulceration, and thus to secondary hæmorrhage, as he considered the mere close apposi-

tion of the coats would not excite adhesive inflammation. He also pointed out distinctly their bad effects in destroying the vasa vasorum of the artery, by insulating it too much, and by the profuse suppuration induced by large foreign bodies in the neighbourhood of the vessels. Strangely enough, his very dread of extensive suppuration seems to have led him to inculcate as useful a meddlesome interference, which would have been almost as mischievous as that which he condemns. For at page 161 we find the following passage:—"It is obvious that every possible means should be employed to prevent the extension of this ulcerative process; hence we should guard against the accumulation of pus about the extremity of the artery, by such pressure as the parts may conveniently bear; by placing the limb in such a position as will allow a ready exit to the pus; and in some instances *by the application of a sponge.*" Had he simply restricted himself to the second part of his plan—namely, attention to position—or at all events completely omitted the last, his advice would have been more in accordance with his own general views.

The views of Dr. Jones regarding the small round ligature were soon very generally adopted and acted on in this country. But, curiously enough, about the same time, and apparently without having seen Dr. Jones's writings, the celebrated Scarpa published his memoir on aneurism, advocating very opposite practice in the ligature of arteries—reviving, in point of fact, the almost exploded views which had previously given rise to the use of the *presse-artère*, and the other measures adopted by the older surgeons to prevent division of the arterial tunics by the too firm constriction of the round ligature. In speaking of the ligature as applied in cases of aneurism, he says, "By the ligature of the great arteries as a radical method of cure of aneurism, *I do not mean a noose, with which the artery is constricted circularly, but I wish to be understood to speak of a pressure made by a ligature of convenient breadth upon the artery, by means of which its two opposite sides are brought into mutual and firm contact, without the noose resting or pressing strongly* upon the sides of the artery, which is *flattened* rather than constricted circularly; and it is in this manner that the surgeon avoids the danger of the rupture of the artery, and of a secondary hæmorrhage, and that he is assured of obtaining the approximation of the two compressed sides of the artery, as if they were two smooth planes placed one over the other, and that they contract an adhesion to each other." . . . . "Generally, on applying the ligature to any of the great arteries of the second order, besides the caution of compressing rather than constricting the artery circularly, the surgeon will recollect that he ties and constricts a living part, upon which the more he increases the degree of pressure, the more he accelerates the ulceration, and thereby the premature division of it. The degree of constriction ought to be such as to place the two opposite sides of the artery in firm contact, but still to preserve as much vitality as to resist the ulceration during all that time which is necessary for the adhesive inflammation producing the union of the sides of the artery, and at the same time the obliteration of its canal. After this time the ulcerative process detaches the ligature, together with a portion of the tied artery, but not a drop of blood is discharged."

The principle, then, which Scarpa inculcates as a preventive of secondary hæmorrhage, seems to be the necessity of preserving the integrity of all the arterial tunics, to prevent too speedy separation of the ligature, and merely to place the surfaces of the internal coat in sufficiently close apposition, that the degree of inflammation excited may cause adhesion between them. From other parts of his work he seems to be fully alive to the value of preserving the vascular connections of the arterial tunics, and specially guards against too great disturbance of the parts around the vessel. Let us now judge, from his own description of the operation for ligature of the femoral, how far his method is consistent with such views. After describing the method of making the preliminary incisions for laying bare the vessel where it is overlapped by the sartorius, he goes on to say that the operator should "divide with one firm stroke the skin and cellular substance down to the thin aponeurotic expansion of the muscle of the fascia lata, which covers the course of the superficial femoral artery; then, with another stroke of the bistoury, with his hand free and unsupported, or on a furrowed probe, he will divide along the thigh and in the same direction as the external wound the thin aponeurosis just mentioned, and introducing the forefinger of his left hand into the bottom of the incision, he will immediately feel the strong beating of the superficial femoral artery, and this, without the necessity of removing the internal margin of the sartorius muscle from its position, or at least very little." "*With the point of the forefinger of the left hand* already touching the femoral artery, the surgeon will separate this artery from the cellular substance which ties it laterally and posteriorly to the contiguous muscles; making the point of the same finger pass gradually under and behind the superficial femoral artery (supposing the surgeon has not enormously large fingers), he will raise it alone from the bottom of the wound, or, when it cannot be avoided, along with the great femoral vein." "If it is along with the femoral vein, holding the artery and vein thus raised, and almost without the wound, the surgeon, with a bistoury or spatula, or simply with the fingers of his right hand, will cautiously separate the vein from the artery, only in the space corresponding to the point of the finger which supports the artery." "He will then pass behind the denuded raised artery a large-eyed crooked needle, with a blunt point, carrying in the eye near to the point two waxed ligatures each composed of six threads." After this the surgeon will withdraw the forefinger of his left hand, on the point of which he kept the femoral artery raised from the bottom of the wound, and will proceed to the ligature of the artery." "He will stretch the two extremities of the tapes, in order to place them near each other; he will then make with each a simple knot, and before tightening it on the artery he will place between it and the knot a small cylinder of linen rolled up, six lines in length and three in breadth, over which cylinder he will tighten both ligatures with a simple knot, and with such a degree of force as he thinks necessary to bring the opposite sides of the femoral artery into complete and firm contact, not forgetting, however, that he compresses a portion of living solid."

"Over the first knot he will make a second, likewise a simple one;

in making the simple knot the surgeon is enabled to calculate the force which he employs in constricting the artery, which he cannot so well ascertain when he employs the double or surgeon's knot as it is called." "Having made the ligature on the artery, he will cut away the ends of the ligatures on a level with the skin, or will bring them towards the upper angle of the wound, and cover them with a bit of linen; he will cleanse the wound from blood, and wash it with tepid water." "He will then fill the bottom of the wound with soft lint, and cover the lips of it with a pledget of simple ointment, and place over it a compress retained by the six-headed bandage."

Then, after directing the more immediate after-treatment of the patient, he goes on to say: "The insulation of the superficial femoral artery with the point of the finger passed behind and under that artery, corresponds nearly to the space which the two ligatures, placed near to one another, ought to occupy; therefore, from not destroying more of the cellular substance which binds the artery to the neighbouring parts, than is necessary for placing the two ligatures, the artery continues to receive its nourishment and life immediately above and below the place of the ligature; which is an inestimable advantage both with regard to the inflammatory course which the artery must pass through at the place of the ligature and near to it, and with regard to the desired effect depending on this inflammation—I mean, the adhesion of the opposite sides of the tied artery to each other." Again, in speaking of ligatures of reserve, he says, "I think that, far from doing good, the placing at the upper part the so-called ligature of reserve rather does harm; for this ligature destroys a great tract of cellular substance, and insulates the femoral artery more than is necessary."

It seems difficult to reconcile Scarpa's views regarding the necessity of insulating the artery only in the least possible degree with his advocacy of his rules for securing and tying the vessel. The writings of Jones and Scarpa, advocating as they did such opposite practice regarding the kind of ligature to be used, and the method of preparing the artery for the ligature, drew considerable attention at the time, and gave rise to much discussion. The views of Scarpa were adopted on the Continent, and had also many supporters amongst our own surgeons; but the conclusions arrived at by Dr. Jones were, in this country, very soon generally admitted as correct.

LECTURE LIX.

Historical Sketch continued—Investigations of Sir Astley Cooper, Hodgson, Lawrence, and Travers—Temporary Ligatures—Sir Charles Bell's Views—Double Ligature and Section of Artery, as recommended by John Bell, Abernethy, and Maunoir—Manec's Views.

MANY investigations were undertaken with a view to test the correctness of the principles advanced by Dr. Jones, and to determine, if possible, points which the results of some of his experiments seemed to indicate, and which, if correct, would remove what still appeared to be imperfections in the ligature. To mention those who took part in these investigations and discussions, would be to enumerate the names of almost every scientific surgeon of the time, and would tend to little use. The names of Hodgson, Lawrence, and Travers, stand pre-eminent among those who adopted the views of Jones; whilst amongst the advocates of the broad ligature, we find along with Scarpa, Paletta, Crampton of Dublin, Roux, and most of the French surgeons. The doctrine that obliteration was caused principally by the adhesive inflammation induced by the presence of the ligature, with or without the division of the arterial coats; that this adhesion was complete within a certain time after the application of the ligature—which subsequently became not only useless but the principal cause of danger in consequence of exciting extensive suppuration in ulcerating its way out—led the advocates both of the small and broad ligature to investigate at what date adhesion was so far completed as to ensure obliteration, and whether the ligature might not then be removed so as to prevent ulceration taking place. In England this question was fully investigated by Sir Astley Cooper and Mr. Travers, the latter of whom made a series of experiments on the ligature of arteries, the results of which were published in the *Medico-Chirurgical Transactions*. His conclusions in his first paper are as follow :—

"That the coaptation of the wounded surfaces of the cuticular coat of an artery, if preserved for a short period after the infliction of the wound, renders its obliteration certain, is a fair inference from these experiments. A more extended scale of inquiry, however, is required to establish the uniformity of their results. They afforded evidence that the circulation was arrested, by the absence of the pulse in the artery continuing after the removal of the ligature; and the vessel was therefore concluded to be as impervious as if the ligature had remained upon it. But upon this event I think it would be impossible to calculate with confidence, unless the ligature were suffered to remain

upon the vessel for a time sufficient to insure the organised adhesion of its sides. In Jones's experiments, the return of the circulation was invariably ascertained after the removal of the ligature; and he seems to have regarded this as a proof that the subsequent obliteration of the canal was effected by a process independent of the coagulation of the blood. But in all these and similar experiments, the blood, as blood, has no concern in the obliteration of the vessel; the conical coagulum of blood is not formed in the first stage of the obstruction; its formation is gradual, and appears to require a change in the properties of the vessel consequent upon the abolition of its function. And although the presence of the conical clot satisfactorily demonstrates the obstruction of the canal, it is sometimes very inconsiderable, and at other times deficient, where the obstruction is complete. It is a mistake, therefore, to regard the coagulum of blood among the immediate effects of the ligature; it is an incidental consequence only of the permanent obstruction which it has been supposed to constitute; without which it never could be formed, nor, if formed, ever be competent to the purpose of permanently obstructing the canal of an artery."

Again, in his second paper, he says—

"It is now well known that the result of tying an artery, and removing the ligature instantly, is a wound or fissure of the middle and internal coats, which is soon occupied by lymph and gradually obliterated by cicatrisation, the vessel remaining pervious. But if three or four ligatures are applied contiguous to each other, forming as many distinct fissures, the lymph is effused in such abundance as to project into the cylinder, and obstruct the passage of the blood. . . . The obstruction of an artery may, I believe, be regarded as an invariable consequence of the application of a ligature for six hours, in the species of animals which were the subjects of these experiments. It is an indispensable condition, however, that the mode of applying the ligature be such as to ensure the division of the inner tunics, a condition which it will be more difficult to prevent than to execute, if the ligature be of a proper form."

He draws the following conclusions from his experiments:—"1*st*, No material obstruction is opposed to the passage of blood upon removing the ligature at a period of six or even of nine hours from its application, and consequently its ultimate obstruction under these circumstances must be referable to the gradual completion of the adhesive process. 2*d*, The persistence of the ligature for a period of six hours affords direct evidence of an inflammatory action in the deposition of lymph between the divided tunics; which deposition is more abundant at nine hours, and sufficient for the obstruction of the vessel in twelve; presenting the form of an interstitial cord between the lips of the fissure, and continuous with it a membranous septum extending across the vessel. 3*d*, The septum of lymph is formed prior to the coagulum of blood, and in all cases of ordinary circulation is of itself adequate to the prevention of hæmorrhage; but under a sudden extraordinary impulse of circulation, or a violent concussion *ab externo*, is liable to be ruptured and give passage to the blood. If, however, an interval of six hours be suffered to elapse after the removal of the ligature, the same violence

is not followed by hæmorrhage, although no coagulum of blood be formed. *4th*, The cylindrical coagulum of blood supporting the septum of lymph is an additional preventive to hæmorrhage under extraordinary impulses. It may be formed at twelve, or may not be formed at twenty-four hours; the nearest collateral branch being equally distant, and the obstruction equally complete in both cases. *5th*, A period of twelve hours is sufficient for the obstruction of the vessel by lymph, so as to admit of the removal of the ligature, and the wound or division of the artery, without danger of hæmorrhage. *6th*, The addition of the pressure of the ligature to the wound which it inflicts accelerates the adhesive process; thus, within a certain limit, the earlier the removal of the ligature the more remote is the period of obstruction. If applied for six hours, it is unsafe to open the artery in less that twenty-four hours; if for twelve hours, the artery may be opened immediately. *7th*, The ligature applied for twelve hours upon the truncated artery is equally safe as upon that which is continuous. *8th*, The coagulum of blood is larger and more extensive in the truncated than in the continuous artery, and is not bounded by collateral vessels, but extends into them; probably owing to the feebler propagations of the heart's impulse along the divided and retracted vessel, and the consequently greater quiescence of the fluid blood."

The same results, however, were not uniformly obtained by other experimenters, and although successful in some cases, when applied to the ligature of arteries in the human subject, in others the results were unfavourable. Mr. Hutchinson, in a case of ligature of the superficial femoral, removed the ligature at the end of six hours, and in less than a minute the artery became distended with blood, and fresh ligatures require to be applied; secondary hæmorrhage occurred, and the case terminated fatally. Sir A. Cooper found the circulation re-established after a period of thirty-two hours. Travers himself, in a case where he had tied the femoral artery, removed the ligature at the end of twenty-five hours, and was ultimately obliged to tie the vessel again in the usual manner to complete the cure. He therefore ceased to commend this practice, and, as far as I know, it has become abandoned entirely in this country. But whilst the advocates of the round ligature in this country were giving up the use of the temporary ligature, Scarpa revived it on the continent. From repeated experiments it was found that the broad flat ligature, applied according to his plan, and withdrawn on the third, fourth, or fifth day, invariably effected complete obliteration of the artery. Paletta mentions two cases, one of ligature of the femoral, and the other of the brachial artery, in which the ligatures were removed on the fourth day. Both cases terminated favourably; and Velpeau states that Scarpa, Biraghi, Molina, Fenini, Maunoir, Wattman, Fitz, Medoro-Solera, Roberts, and several other continental surgeons, had operated with success by this plan, in cases of aneurism of the carotid and femoral arteries. There can be little doubt that the removal of the broad flat ligatures and linen cylinders of Scarpa and his followers, at a period before their presence gave rise to excessive suppuration and ulceration, was a thing very desirable, where this could be effected without great disturbance to the parts, and might

have in some degree obviated the other evils consequent on the broad ligature. We do not therefore wonder at Scarpa attempting to lay it down as a principle of practice in every case, as he must have found the bad effects of the continued presence of a large foreign body around the artery, and its removal was perhaps the less of two evils. But in cases where the small round ligature is used, its presence is comparatively free from risk, whilst the removal of the ligature is not, and therefore the plan, as I have already said, has been abandoned in this country even by its originators.

Next in the history of the ligature may be mentioned the attempt by Mr. Lawrence and others to diminish its size, and, by cutting off both ends close to the vessel, to allow the external wound to heal over it by the first intention. This was very readily effected in many cases, but unfortunately it was found that the small knot would not remain quiescent, for, however fine the silk employed, and however well the wound healed in the first instance, small abscesses formed till the ligature was expelled. Sir A. Cooper in England, and Physick and Jameson in America, tried the use of animal and metallic ligatures, such as catgut, strips of deer-skin, threads of gold, silver, lead, and the like, in hopes that they might be absorbed or remain quiet, but the results hitherto obtained have all gone to prove that the ligatures must be expelled sooner or later, and that, like other foreign bodies, they are incapable of being absorbed. The plan of cutting off both ends of the ligature recommended by Lawrence, however, has been found useful in those cases where we do not wish or cannot hope to obtain union of a wound by the first intention, and where the presence of the ends of several ligatures would irritate the granulating surface as so many foreign bodies.

The use of catgut ligatures has been recently revived by Mr. Lister in connection with his system of antiseptic surgery. The catgut is most carefully carbolised beforehand, so as to render it thoroughly aseptic, and it is preserved in carbolic oil until required. The advantage claimed for this form of ligature is, that after we apply it we see no more of it. At first it was supposed that it became incorporated with the arterial coats—organised in fact. This view has been abandoned however, and the more rational theory that it softens and dissolves, and is thrown off insensibly with the serous discharges of the wound is held. In tying smaller vessels after the removal of tumours or in amputations, and other operations where the vessels are not large, it is a most convenient ligature, seeing that we are enabled to close the wound without projecting threads, but I do not trust to it in the case of large arteries such as the axillary, in amputation at the shoulder, or the femoral in high amputations of thigh—still less would I trust to it in tying a large continuous artery for aneurisms near the centre of the circulation. The advocates for its use in the latter cases, maintain that seeing that it does not ulcerate through the vessel there is consequently less risk of secondary hæmorrhage. It softens, however, and dissolves, or it gives way at some point of its constriction, and hence, in stumps, it may slip off the vessel, or remaining on it loses its constricting power, and in this way secondary hæmorrhage may and does occur. In a case of ampu-

tation of the thigh in my own wards, the house surgeon found the ligature apparently constricting the femoral, but on removing compression above the blood came in a full stream. In this case the catgut had softened and lost its controlling power; fortunately the bleeding had been noticed in time and the patient did well. I have also seen secondary hæmorrhage from the axillary artery in a case which was treated under the strictest principles of antiseptic surgery. In a case in which I tied the carotid artery the patient was seized with a convulsion and coma on the second day after ligature, and after death I found the ligature softened like gelatine. It had given way at one point of its circle, and the force of the circulation had broken up the recent changes and carried a small clot into the middle cerebral artery. The middle and internal coats were divided as by the ordinary silk ligature, but the external appearance of the vessel showed no constriction on indentation—merely the knot and the ligature adhering to its surface. Many explanations, and some of them not in accordance with fact, were brought forward to explain away this failure of the carbolised catgut. That generally held now is, that the ligature at this time was not uniformly well prepared, and that I had been so unfortunate as to get bad catgut. In answer to this I can only state that I obtained it from a department where the use of the catgut was said to be so satisfactory as never to be attended with a bad result. No chain is stronger than its weakest link, and therefore I am not prepared to trust the catgut ligature in such cases I have mentioned. Furthermore, we would require to know whether the obliteration of the artery is complete in every case where catgut is used for ligature of an artery for aneurism—in other words, whether recurrence of pulsation and failure of cure is not more frequent than when the silk ligature is employed.

Taking everything into account, I consider that the very solubility of the catgut, which renders it so advantageous for small vessels, renders its behaviour very doubtful in large arteries, and hence in such cases I prefer carbolised dentist's silk as a trusty ligature.

It now only remains for me, before I close this history of the ligature, to speak of the views of some surgeons who differ both from Scarpa and Dr. Jones as to some of the essentials for obliteration, or at least as to the mode in which the process is effected.

Sir Charles Bell, in his work on *Operative Surgery*, published in 1814, says:—"The principle which shall direct our endeavours in the stopping of hæmorrhage will be discovered, if the question can be satisfactorily answered, What is it which preserves the blood fluid in the vessels?" and he concludes by stating as his opinion, "that there is an influence of life in the coats of an artery which prevents the blood adhering and coagulating within it; but that, when this natural influence is destroyed or disturbed, presently *the blood coagulates within the vessel*, and if the vessel be of moderate size, the flow of blood is obstructed." Adverting to the use of the ligature and its form, he says—"To the full effect of a ligature upon an artery it is necessary that the mouth be securely closed, and the thread in close contact with the coats of the vessel. In tying an artery firmly the inner coats are cut through; but it is a mistake to suppose that it is necessary to the union of its

coats, or that there must be, as it were, an incised wound, to secure the adhesion of the sides of the vessel. When this notion was first broached I cautioned my pupils against the next step; I thought an attempt would be made to tie a ligature on the artery of an aneurismal limb, and take it off again; this has since been done, and failed. I at the same time showed, that although any sort of injury to the coats of the vessel would in certain circumstances cause a coagulum to form, and the artery to be closed, yet, that so far from the cutting of the inner coat being the sole means of producing the union by ligature, it was not even necessary; for if the ligature was cast about an artery, and left without being drawn, so that the blood might still pass it, the consequences will be the inflammation of the coats, the formation of a coagulum, and the final closing of the vessel."

The parts of the process, then, which Sir Charles Bell seems to regard as essential, are the two last mentioned—the adhesive inflammation of the coats, and the formation of a coagulum within the artery. With regard to the form of ligature, his rule of practice is, "proportion the ligature to the size of the vessel," apparently with a view to avoid division of the arterial coats. And in his work on the *Great Operations of Surgery*, published in 1821, in describing the operations for aneurism, he directs the ligature to be composed of "three strong silk threads laid parallel and waxed," which would form a small flat ligature; but he differs materially from Scarpa and his adherents as to the precepts he gives for operating, which may be summed up as follows:—That, in exposing the vessel the surrounding parts should be disturbed as little as possible. That the sheath be opened immediately over the vessel, and merely to a sufficient extent to disclose it. That, whilst the proper coats of the artery are exposed to the contact of the ligature, injury to its cellular connections and the vasa vasorum must be carefully avoided. That the parts be relaxed by attention to position of the limb whilst the surgeon passes the ligature, to avoid traction on the vessel; and lastly, that the loop and knot be *sunk into the coats* sufficiently to prevent the pulsation of the vessel shifting the ligature, but not drawn so tight as to cut the inner coats of the artery. In opposition to the practice advised by John Bell, Abernethy, and Maunoir, Sir Charles Bell prefers a single ligature in operating for true aneurism; and in a footnote, at page 94 of his above quoted work, he makes the following remarks:—"Mr. John Bell, and Mr. Abernethy, and M. Maunoir of Geneva, have been advocates for tying the artery twice and cutting it betwixt the ligatures. It is a practice which may have advantages, but the idea that they thereby made the artery as secure as when tied in amputation was undoubtedly a great mistake. Has the profession still to learn the difference of the condition of an artery where the limb is cut off, and with it is removed the stimulus to the activity of the vessels, and of an artery tied in the centre of a limb, where the member still influences the condition and activity of the trunk and its branches?"

The latest, and one of the most elaborate, monographs on the ligature of arteries is that of M. Manec. He coincides in the opinions of Jones as regards the use of the small round ligature, and as to the

effusion of lymph and union of the internal coats of the artery in the first instance. But he considers that these changes would, in themselves, be insufficient to prevent secondary hæmorrhage at the period of the separation of the ligature, and states that his experiments and observations led him to the conclusion that the coagulum, together with its gradual and vital connections with the internal coat of the artery, form the essential part of the process of final obliteration.

After carefully describing the gradual formation of the clot, its increase in length in the first instance, and then in thickness from the centre towards the circumference of the canal of the artery, and the effusion of plastic lymph upon the internal coats of the vessel, until these come into contact, he states that "The first effects of the vital impulsion made upon the coagulum, and the coagulable lymph by which it is united to the sides of the vessel begin to be visible between the sixth and tenth hour after their union is completed, and are indicated by the surface of the coagulum and the substance connecting it with the internal membrane of the vessel assuming a filamentous appearance, which soon becomes areolar. This gradual change of coagulated blood into lamellated tissue extends through the successive layers of the entire substance of the coagulum; but previously to the central portion having reached this degree of vital organisation, red-coloured striæ appear in those parts which are nearest to the artery. These seem to be absorbent vessels, which slowly and imperceptibly take away the colorific principle of the blood, for the purpose of throwing it into the course of the general circulation; and when this substance no longer exists, the striæ lose their colour, become solid and much more resisting than before, and ultimately terminate in forming the basis of the fibrous web into which the coagulum is always changed. It is probable that each filament is formed of an obliterated vessel."

M. Manec then proceeds to show the necessity of such a coagulum being present at the separation of the ligature. "During the period that inflammation is extending upon the surface of the artery, it also penetrates to the centre of each of its extremities; but, as in this point it meets with the inflammation which has already taken place in the divided lips of the internal and middle membranes, its intensity is here increased and suppuration ensues; and thus the adhesion uniting these parts to each other and to the base of the coagulum is always destroyed. It hence appears that the means which nature primarily employs for obliterating the vessel entirely disappears; *and at this time the coagulum and its union with the internal membrane offer the only preservative against consecutive hæmorrhages.* The positive necessity, therefore, of the presence of a coagulum of considerable size to render the operation successful is evident, whether it shall have been performed on an artery of a large or middle size, as, for example, the crural and brachial."

LECTURE LX.

Review and Appreciation of the different Opinions discussed—Results of the Author's original Investigations.

A REVIEW of the history of the ligature will be found instructive, as showing the gradual progress of any great doctrine towards perfection, although all the principal facts in the process may have been long known. When we look at the principles laid down by Dr. Jones as the results of his investigations, and for which he has received so much credit, it will be found that the great service he performed consisted not so much in pointing out any new fact observed in the process of obliteration of an artery, as in scientifically investigating the subject as a whole, ascertaining in a great measure the relative value of the different parts of the process, and drawing from his experiments sound practical deductions as to the causes of secondary hæmorrhage, and as to the best means of procuring obliteration. Each part of the process on which he insists had formerly been noticed, as we have seen, by one or other of his predecessors. Thus, the division of the internal and middle coats of the vessel had been fully pointed out by Desault, Bichat, and by the late Professor John Thomson; but the two former had regarded it rather as an imperfection than as tending to promote adhesion in its simplest form, whilst to Professor Thomson we believe Dr. Jones was indebted for being directed towards this inquiry. The coagulum within the artery, its shape and supposed value, had formed the subject of the extended investigations of M. Petit. From overrating its value, as the one essential, he had overlooked the other and more important parts of the process, and so was led to erroneous conclusions. The external effusion and thickening around and upon the coats of the artery, and the occasional absence, and consequently the non-essentiality of the clot, had attracted the observation of Pouteau. But from his attributing this thickening to a wrong cause, and from not viewing it in connection with other parts of the process, he was led away from perceiving its true value and beauty in the operation (of which Dr. Jones also seems ignorant, and scarcely alludes to it, except as incidental), and brought to advance a very dangerous practical doctrine.

Obliteration of the canal of the artery in consequence of the adhesive inflammation excited by the ligature—the part of the process so much insisted on by Jones—together with the ulcerative process for separation of the ligature, had been very fully pointed out by John

Bell. And, indeed, if we make allowance for the plan of operation he describes, and his peculiar style of description, he seems to have almost forestalled Dr. Jones in regard to these particulars. Whilst, as regards the determination of the blood on the collateral branches, the ultimate enlargment of these, the manner in which the circulation is re-established above and below the deligated point, and all that regards the collateral circulation, Mr. Bell had left but little for any one to add. Nevertheless, it is to the investigations of Dr. Jones, as we have already said, that the profession is indebted for consolidating our knowledge of all that was truly valuable in the vague notions entertained by those who had investigated the subject before him, by pointing out the different steps of the process from first to last by direct experiment. And though, in common with others, he may not have estimated each part of the process at its true value, still the general principles he deduced as to practice are so correct, that, as they gained ground rapidly at first, they have stood the test of the past with slight modification, and are still likely to continue in favour.

The controversy caused by the publication of Dr. Jones's experiments, when the various statements of Scarpa and others are carefully examined, seems rather to involve the question as to what are the best *means* of producing the same effects, than a difference of opinion as to the *cause* which he considered *essential* to obliteration. Both Jones and Scarpa point to the adhesive inflammation between the internal coats of the vessel, excited by the ligature, as the principal cause of permanent obliteration. And both insist equally on the value of the vessels of the sheath (the vasa vasorum), as the source of the vitality of the artery, and consequently on the necessity of avoiding all unnecessary injury of these vessels. It is true that those who advocated Scarpa's plan of the broad ligature, in opposition to that of the small ligature recommended by Dr. Jones, seem to point to the division of the internal coats of the vessel described by Jones as the main difference and the principal point to be avoided. But Scarpa himself, when speaking of the broad ligature, whilst he insists upon the integrity of all the coats as *one* advantage, also points out what he considers another advantage—namely, the preservation of the vessels of the arterial coats from undue constriction—and is accordingly very particular in his directions as to tying the vessel sufficiently tight to flatten and bring its internal surfaces into contact, but not so tight as to constrict the vasa vasorum or divide the coats.

From what has been stated, the fallacy of Scarpa's practical deductions would, I believe, have been more readily recognised, had Dr. Jones and his followers, instead of insisting on the division of the two internal coats effected by the small round ligature as one of the essentials to obliteration of the vessel, contented themselves with pointing out that this result of the small ligature effected adhesion of the divided surfaces in its simplest form; whilst, from causing little disturbance of the sheath, the small ligature better preserved the integrity of the nutrient vessels of the artery; and that these advantages greatly overbalanced the supposed risk of dividing the internal tunics. Though all ligatures, even the broad ligature of Scarpa, produce division more or

less complete of the internal coats, still there are sufficient facts to prove the statements of Bichat and Scarpa, and their followers, that this is not absolutely essential, and indeed no one now doubts that the adhesive process between the coats of an artery, and consequent obliteration, may be effected without division of the internal coats of the vessel. This fact, however, by no means proves the correctness of Scarpa's doctrine as to the use of the broad ligature, for experience has shown that the complete division of the internal coats of the vessel by the small ligature really involves no risk, whilst, in respects to other points admitted by all parties, its advantages are incontestable. Laying aside, then, the advantages gained or risk incurred by the division of the internal coats, we find that both Scarpa and Jones agree as to the two great essentials necessary to obliteration of an artery:—1*st*, The excitement of inflammation, causing effusion and adhesion between its coats; 2*d*, The preservation of the vasa vasorum as the source from which the arterial tunics are to receive their nutrition, and that vitality on which will depend the ability of the vessel to undergo the changes necessary in the process of obliteration. Both Scarpa and Jones seem to consider the clot as merely incidental. The expressions I have quoted from Sir Charles Bell's writings seem to indicate that, in his opinion, the formation of a coagulum within the vessel was essential to cause obliteration.

Manec is decided in expressing his opinion as to the clot being absolutely essential, for he states that his experiments led him to believe that the ulcerative process necessary for the separation of the ligature extends to and destroys the recent adhesions between the internal coats. And in the passages I have quoted he has pointed out carefully the successive steps in the formation and gradual organisation of the clot.

Having now presented a pretty full statement of the principal opinions at present held regarding the changes induced on an artery by the action of the ligature, and what parts of the process are absolutely essential, I shall next proceed to give you the results of my own experiments on this subject, and the views which these have led me to adopt as to the parts of the process absolutely essential to safe obliteration. I shall also state in what respects they seem to elucidate some points on which a difference of opinion existed at the time when I entered on the investigation.

My experiments on the effects of the ligature of arteries consisted of two series. Of the first series, a brief abstract was published in the *Edinburgh Medical Journal* for June 1843. In it I sought more particularly to draw attention to two points which appeared to me to have sufficient importance to merit further investigation. These points were, the essential value of the external plastic effusion, and the non-essentiality of the internal coagulum.

The second series of my experiments was instituted to investigate still further some points which had not been quite satisfactorily ascertained in the first—namely, to ascertain the further process of organisation and vascularisation of the external plastic lymph—the various changes which the internal coagulum undergoes when it is present—the

extent of obliteration in the deligated artery, and some questions connected with the collateral circulation.

The results of these experiments directed my attention more particularly to the relative value of two points in the process of obliteration of an artery by ligature—namely, the clot and the external effusion of lymph. When I commenced these experiments I held the opinions expressed by Manec:—That the presence of a coagulum within the vessel, filling up its canal for some distance, and ultimately becoming adherent to and incorporated with its parietes, was an essential to perfect obliteration and the principal obstacle to secondary hæmorrhage at the decidence of the ligature. My experiments showed me that, however common the presence of a clot, or however valuable as an accessory it might be when present, it was not an essential in the process. Inasmuch as the obliteration was as perfect, and without any occurrence of secondary hæmorrhage, in cases where the coagulum was wanting as in those where it was present. This caused me to re-examine some preparations which I had formerly made after ligature of arteries, and these still further established the fact of the absence of the clot in many instances where the vessels were fairly obliterated. Thus, in two preparations, where the dogs had been killed about two months after ligature of both carotids and both vertebrals, I found that in both instances the vertebrals and one carotid were pervious close up to the deligated points; whilst, in each of them, one carotid (in the one instance the right carotid, in the other the left) exhibited the presence of a considerable clot.

In a stump of a leg, which I dissected six weeks after amputation, I found the anterior and posterier tibial arteries pervious to common wax-injection up to the point tied, and contracted in calibre, but presenting no appearance of a clot. I have also in my own possession two specimens of femoral arteries eight weeks after amputation, where the stumps had cicatrised without the occurrence of secondary hæmorrhage. In one there is a large firm coagulum adherent to the sides of the arterial canal. In the other there is not the vestige of a clot, but the artery is contracted towards the deligated point, and compressed externally by the firm lymph effused around its extremity (plate xxiii. figs. 1 and 2). All these cases seem to prove that the presence of the sanguineous coagulum is an incidental circumstance, and not an essential to obliteration of the vessel. Dr. Jones, it is true, had stated as his opinion that the clot was not essential; but of all his experiments with the ligature, I can only find one—namely, Experiment xiii. (page 155)—where there was no clot, and in that case the vessel is stated to have been much contracted and thickened in its coats. I had therefore regarded his statement more as a matter of opinion than as a fact proved by his experiments. Moreover, the value of the clot had been latterly more insisted on. The carefully-conducted experiments of Manec, and the deductions he drew from them as to the essentiality of the clot at the period of the separation of the ligature, seemed to me so plausible, that I had come to adopt them, and consequently, as I have already said, until I began these experiments I looked upon the clot as the principal obstacle to secondary hæmorrhage. But although I think

that my experiments and the facts just stated sufficiently disprove such a view, it is well in all cases to investigate the causes of different opinions, and such an inquiry may serve to explain what I consider the source of fallacy in M. Manec's views. He proceeds upon the supposition that the primary adhesions between the divided edges of the tunics of the vessel are destroyed by the ulceration necessary to free the ligature, and that, consequently, if there be no clot to oppose the current of blood, secondary hæmorrhage must occur at that period. Now I conceive that there are two errors in the views on which this theory is founded 1*st*, That the internal effusion of lymph is limited to the mere union of the divided edges of the internal coats of the artery. 2*d*, That in the event of the primary adhesions of the internal tunics being destroyed, there would be nothing to prevent hæmorrhage except the clot.

As regards the former of these errors, it is doubtless to a certain extent true that the ulceration necessary to separate the ligature from the vessel will in most cases affect the recent adhesions immediately contiguous; but if the process goes on favourably, the suppuration is so trivial that it can only do so to a very slight extent. The internal effusion of lymph, instead of being a mere layer uniting the divided edges of the internal coats of the vessel, is in fact of very considerable extent within its canal, sometimes from two to three lines in depth. So that, though the surface immediately in contact with the ligature be destroyed, there is still sufficient firmness of union to resist a considerable impetus of blood, and to prevent it passing through that part of the vessel at the separation of the ligature. This resistance is still further favoured by the other conditions of the artery at this period; these we shall notice immediately. The constancy of the existence of an internal coagulum of plastic lymph blocking up the canal of the vessel for some distance, and uniting the surfaces of the internal tunics beyond their divided edges, can be readily demonstrated, and is indeed generally admitted. I insist more particularly on this point, because, in speaking of the coagulum, writers have not been sufficiently careful to distinguish between the true plastic effusion, which is constant and essential to safe obliteration, and the simple bloody coagulum, which is only incidental and not essential. The distinction between these two parts is best seen in a vessel examined from the ninth to the fifteenth day after ligature, in which there is a large clot. If such a vessel be opened immediately on the animal being killed, and a section of the coagulum made *in situ*, the distinction between the plastic and mere bloody coagulum is very apparent, even to the naked eye, and still more so when examined by a low magnifying power. In plate xxii. fig. 6, I have given a view of the femoral artery of a dog, at the seventeenth day after ligature, viewed by a low magnifying power, the drawing being made whilst the natural colours remained unchanged. In this artery the plastic coagulum, occupying its canal immediately above the point of deligation, exhibited on its section a peculiar gelatinous appearance, of a yellowish-pink colour, perfectly distinct from the dark sanguineous clot which is seen lying in contact with it. It is necessary to keep in view these two distinct original portions of the coagulum to understand their respective constancy and value in the process of

obliteration, and also the subsequent changes which take place as to the vascularisation of the sanguineous clot when it is present, to which I shall have again to refer more particularly.

So much for what I consider the first erroneous notion on which M. Manec founds his views of the necessity of a clot within the vessel as essential to safe obliteration after ligature. His second proposition, deduced from the former, can, I believe, be shown to be almost as erroneous. For, even supposing the internal adhesion were completely destroyed by the process necessary for separation of the ligature, I hold there are other conditions of the artery which would guard against secondary hæmorrhage at that period. The walls of the vessel are thickened, and its canal contracted for a considerable distance beyond the deligated point; thus opposing a considerable obstacle to the flow of blood through it, a fact long noticed by many writers. But besides this, I think the external effusion of plastic lymph, when its uses in the process are fully examined, will be found to be of itself sufficient to oppose a barrier to the occurrence of secondary hæmorrhage.

The effusion of plastic lymph on the exterior of the artery is a part of the hæmostatic process which my own experiments have shown me to be of great value, as tending to prevent secondary hæmorrhage, and as supporting and favouring the changes in the interior of the vessel. This has hitherto been very little attended to, and its true value overlooked; I therefore wish to enter more fully into a consideration of its gradual formation, and what appears to me to be its use in the process of obliteration of an artery.

Even so early as forty-eight hours after the ligature has been applied, we find that the lymph effused from the vessels of the sheath and neighbouring parts has enveloped the exterior of the artery, and begun to consolidate around and contract adhesions to the arterial parietes: that the mass of lymph extends for some distance above and below the ligature, pressing upon the vessel; and on a section of the vessel being made, the lymph is found projecting into and filling up the groove formed by the ligature. At ninety-six hours, the plastic matter has become still further organised. It is firmer in structure, and inseparable from the cellular coat of the artery, with which it is evidently incorporated, and a section of it shows it sending distinct bands of plastic matter from the part of the vessel below to that above the point tied, as well as filling up the groove formed by the thread. If the vessel be examined when the ligature is separating, the lymph around it is found still further contracted and consolidated, and the portion projecting into the groove formed by the thread is found to have completely filled up the space from which the ligature has passed, forming the medium of union between the divided ends of the vessel. The knot of the ligature is found enveloped in a sort of cup-like cavity or cyst, and the ends of the ligature are enclosed in a tubular sheath of firm lymph, whilst the section of the vessel shows that the portion of the external lymph situated between the ends of the artery has come in contact with the plastic lymph effused within its canal. When examined after the ligature has been discharged and the wound healed, we find the effused lymph beginning to undergo absorption and alteration in structure. It

then presents much less bulk, and is of a fibrous appearance, and this fibrous appearance is very distinctly visible on making a section of it. There is now no apparent distinction between the internal and external lymph, which seem blended to form the new fibrous structure. At a still later period, say twenty-eight or thirty days after tying the artery, even the small knot of lymph between the ends of the vessel at the deligated point is completely absorbed, and a dense fibrous tissue occupies its place, uniting the ends of the artery divided by the thread (see plate xxi).

From a consideration of these facts, I was convinced that the external effusion of lymph around the artery was of great importance in the process of obliteration by ligature, as assisting the internal changes. First, by pressing upon the vessel for some distance above and below the deligated point, it must necessarily diminish the calibre of its canal, and thereby lessen the impulse of the blood in the neighbourhood of the ligature; and this pressure and contraction will be gradually increasing as the lymph consolidates. Secondly, by becoming incorporated with the arterial parietes above and below the ligature, and projecting into the groove formed by it, it will serve in the first instance to support the internal plastic coagulum. Next, to commence the union of the ends of the vessel on either side of the ligature; and lastly, this plastic matter passing into the groove formed by the thread, enclosing the knot, and following in its track, will serve as a support to the internal adhesions at the separation of the ligature. At that period a sort of double action seems to be going on—the ligature ulcerating its way out, whilst the reparative process of effusion of plastic lymph, following in its track, keeps pace with its separations—a process in fact analogous to the old operation for fistula, with the gradually tightened wire. The reparative process literally following step by step in the track of the ulceration.

LECTURE LXI.

Results of a Second Series of Experiments on Deligation of Arteries—Organisation and Vascularisation of the External Plastic Effusion—Its Vital Connection with the Internal Plastic Effusion and Blood-clot after decidence of the Ligature—Value of the External Plastic Lymph in the Process of Obliteration—Practical Deductions.

The Blood-clot: its Proper Function; its Value as an Adjuvant in the Process—Extent of Obliteration of a Vessel after Ligature—Practical deductions.

My second series of experiments on the effects of the ligature, whilst it confirmed the results of the first as to the constancy of the presence of plastic effusion, and the changes which that effusion undergoes at different periods after the application of the ligature; shows further the mode of its development, and the manner in which it is fitted for the purposes which it is destined to fulfil.

The results of these experiments proved that the plastic lymph effused around the artery tied, becomes very rapidly organised and vascularised. Even at the lapse of sixty hours we find it traversed in every direction by a complete network of minute vessels ramifying in its substance, and passing from it upon and into the proper coats of the artery. These inosculate with the vasa vasorum on the arterial coats, assisting in the nutrition of the latter, increasing their vitality, and fitting them for the functions they are now called upon to perform. This great vascularity of the lymph evidently adapts it for the rapid development of new matter following in the track of the ligature, as the thread ulcerates through the cellular coat. When that has taken place, the newly-effused lymph serves as the medium through which vessels shoot into the internal plastic coagulum, and through it into the sanguineous clot, when it is present,—connecting these structures, and thus forming a firm union between the divided ends of the vessel (plate xxii. fig. 3). Later in the process, when the greater part of the lymph has been absorbed, and its remains assume the form of the fibrous texture between the ends of the vessel, the new tissue is still remarkable for its vascularity (plate xxiii. fig. 3). The plasticity and vitality of the plastic effusion round the vessel fit it admirably for the reparative functions of nourishing and supporting the arterial coats, for aiding the internal changes requisite for obliteration, and for preventing the occurrence of secondary hæmorrhage, in case of the internal adhesions being disturbed. Of this I had an example in one of these experiments, where, from some cause, the union of the internal coats had been destroyed, and the clot displaced both on the proximal and distal side of the deligated part

of the vessel; but where the consolidated lymph around the artery had completely prevented hæmorrhage taking place (plate xxii. figs. 4 and 5).

I consider that the facts and reasons I have stated sufficiently warrant my conclusion regarding the value of the external plastic effusion, as one of the essentials to the safe obliteration of an artery after ligature, but I am far from regarding it as pre-eminently THE essential, independently of the other parts of the process. For although in some of these experiments the external lymph seemed ultimately to be the only obstacle to secondary hæmorrhage, still, it must be recollected that in these cases the internal adhesions must have formed the barrier until it had been sufficiently consolidated to resist; and hence that, without the aid of these other parts of the process, the external plastic effusion might not, in itself, have been sufficient.

I have already said that very little attention has been hitherto directed, in this country at least, to the value of the plastic effusion on the exterior of an artery after ligature. For although the constancy of the presence of that part of the process must have been noticed by all who have investigated the subject, they seem to have regarded it more as an incidental occurrence than as essential. Pouteau, indeed, had at a very early period noticed the closure of the vessel by means of the condensation around its extremity, and had specially directed attention to it as essential. Unfortunately he had taken an erroneous view of the sources of that condensed structure; supposing, in fact, that it was derived from condensation of tissues included in the ligature along with the artery, instead of perceiving its true character as new matter effused from the vessels of the surrounding parts. Hence the erroneous and dangerous practical deduction which he drew from these false premises—namely, that the more of the surrounding parts included in the ligature, the greater the security against secondary hæmorrhage, doubtless did much to prevent future investigators from attending to this part of the process.

It now only remains, as regards this part of my subject, that I should point out some practical deductions as to the operation of tying an artery, drawn from a consideration of the development and functions of the external plastic effusion. 1*st*, As the plastic effusion is furnished not only by the vessels of the sheath, but also, and principally, by vessels of the surrounding tissues in the deep-seated part of the wound, we must be careful to avoid not only undue separation of the sheath from the arterial parietes, but also all unnecessary manipulation of the surrounding parts, lest we induce suppuration, which may either prevent the formation or end in the destruction of the lymph. 2*d*, If the surrounding tissues, owing either to accident or disease, be in a state of impaired vitality, the requisite plastic effusion can scarcely be expected to take place, and tying a large vessel under such circumstances must always be attended with a risk of secondary bleeding on the separation of the ligature. Therefore, in some cases, the ligature ought rather to be placed on the vessel, at some point nearer the heart, where it is surrounded by healthy parts. I am aware that this has been severely reprobated in cases of opened arteries, as where the vessel has

Fig. 1

Fig 2

Fig 3

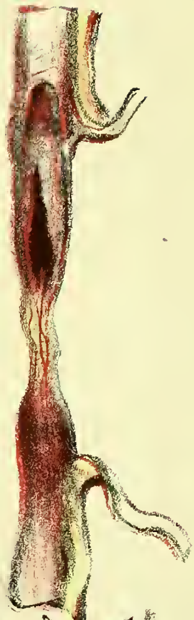


Fig 4

Fig 5

Fig. 6

sloughed, in consequence of severe burns, or other causes, and where the unhealthy action is still going on. It has been said by Mr. Guthrie, that in such cases tying the artery higher up is bad practice, as the free collateral circulation will infallibly give rise to retrograde bleeding from the lower part of the vessel. But it is equally evident, I think, that the ligature above and below the opening, in such a case, could not be expected to hold above two or three days; as, from the impaired vitality both of the vessel internally and externally, and of surrounding parts, there is no tendency to effusion of plastic lymph necessary for the reparative process. Unless, therefore, something be done to prevent the direct impulse of the blood upon the weakened part, secondary hæmorrhage would almost certainly occur. I consider it the better plan to tie the artery where it is surrounded by healthy parts, whilst we also apply ligatures above and below the ulcerated opening in the artery, so as to prevent retrograde hæmorrhage and allow of proper dressing being applied to the parts. In this manner I treated a case of bleeding from the brachial at the bend of the arm, in consequence of severe burn, involving the limb up to the axilla. I placed ligatures above and below the opening in the brachial, and then tied the lowest third of the axillary artery. The lower ligatures separated on the third day, without hæmorrhage, that of the axillary on the thirteenth; and the patient did quite well.* *3d*, As the plastic effusion must depend upon the quantity and healthy character of the circulating blood for its development, it is evident that any state of the general system which will give to want of healthy action in the neighbonring parts, from the low state of the circulation, or which will alter the healthy character of the blood, must necessarily interfere with the development of the new formation, and impair its fitness for the functions which it has to perform, either by not furnishing it in sufficient quantity, or else giving rise to an effusion possessed of less plasticity than is requisite for the reparative processes it has to effect. Hence, whilst in the after-treatment of patients in whom large arteries have been tied, we avoid the use of stimulants as a rule, we must, on the other hand, be careful to give nutritious non-stimulating diet, to support the strength and furnish the healthy plasma necessary to effect the hæmostatic process.

In the deductions drawn from my first series of experiments, I stated my conviction that the clot was not essential to safe obliteration of an artery, and I did so because I had repeatedly found it absent while no untoward occurrence had taken place during the process. But whilst I still look upon the clot as not absolutely essential to obliteration, it is so very generally present, and so obviously useful as an adjuvant to the other parts of the process when present, that it has always obtained a considerable degree of attention, and various theories have from time to time been propounded as to its formation, organisation, and ultimate connection with the arterial coats.

To M. Manec we are indebted for the most carefully-detailed investigation on the subject of the coagulum. He regards it as acting as a firm plug within the vessel, ultimately becoming organised and adherent to its inner surface; and, according to his view, it is the only

* See Clinical Cases.

obstacle to secondary hæmorrhage at the period of separation of the ligature. As to this latter point, I have already shown that its presence cannot be absolutely essential, as it is frequently absent without secondary bleeding taking place, and that, even supposing the internal adhesions to be as completely destroyed as M. Manec supposes, at the separation of the ligature, the external plastic effusion around and between the ends of the vessel forms a sufficiently firm barrier to prevent the secondary hæmorrhage. In corroboration of this view, I would again refer to the experiment in the second series, where the internal adhesions had been destroyed and the clot displaced, and where the external lymph had effectually prevented bleeding. But apart from his peculiar view of the absolute essentiality of the coagulum, M. Manec's account of its gradual formation, and the general changes which take place in it and the part of the artery with which it is in contact, is corroborated in most respects by my own observations in cases where the coagulum was present. I have not, however, observed the strong organised adhesions of the clot to the sides of the artery, remarked and described by Manec, till a late period. On the contrary, I have never found the coagulum firmly connected, except at its base, and this led me to examine more carefully as to the progress of its vascularisation. The result was such as leads me to believe that vessels enter the clot from its base in the first instance, through the new and highly vascular lymph effused between the ends of the artery at the point from which the ligature was separated, and that the lateral adhesions to the inner surface of the vessel take place at a later period. Indeed, in my own experiments, I have never been able to trace any vascular connections between the sides of the clot and the arterial parietes. M. Manec admits that he has never been able to inject the connecting vessels, the injection having always become effused between the clot and sides of the vessel; whereas, I have been able distinctly to see vessels entering the base of the clot. In one of my experiments of the second series, I traced them distinctly ramifying from the recent lymph into the coagulum (plate xxii. fig. 3). I believe, then, that the coagulum, when present, though not absolutely essential, is useful in assisting the process by acting as a plug and preventing the impulse of the blood upon the deligated point; that afterwards it gradually becomes organised, and is incorporated with the arterial coats, and like them is subjected to vital changes, and gradually altered in structure.

As regards the Extent of Obliteration, Dr. Jones has stated, in his summary of the effects of tying an artery, that one is "to produce indirectly a complete obliteration, not only of the canal of the artery, but even of the artery itself, to the collateral branches on both sides of the part which has been tied." This statement has been repeated by almost every surgical writer since his time, as one of the constant effects of the operation. Now, I have no hesitation in saying that this statement is erroneous. It is not true (independently of peculiar circumstances) that an artery after ligature is constantly or even generally obliterated up to the nearest collateral branches on each side of the point tied, unless these branches arise at no great distance from that part of the vessel. In proof of this, I may refer to the prepara-

tions of the anastomosis after ligature of both vertebral and carotid arteries made by me, which are now in the University Museum; also to a similar preparation in my own possession, and to several of my dissections of the arteries of stumps, which are contained in the Anatomical Museum of this University.

By looking at the preparations referred to, any one may satisfy himself that, even when there is a large extent of artery without any collateral branches to interrupt the process, the actual extent of obliteration seldom exceeds an inch and a half or two inches; showing that this is all the space which nature absolutely requires for the safe closure of an artery after ligature. Having thus compared the usually received statement with the actual facts of the case, I would now call attention to the practical bearing of these facts.

It has been said, that as a portion of artery which gives off many collateral branches is unfavourable for ligature, so, on the other hand, a vessel which gives off no collateral branches for a long distance is placed in the most favourable circumstances for the operation, as, owing to the great extent of obliteration, there will be little risk of secondary hæmorrhage from the impulse of the retrograde circulation. Now it is perfectly true that if an artery be tied at a part where several branches arise in close juxtaposition with each other, there will be a great risk of secondary hæmorrhage; because, owing to the force of the retrograde circulation through the anastomoses, *obliteration never passes beyond the nearest collateral branch.*

If we dismiss, as incorrect, Dr. Jones's statement that the obliteration *always extends up to* the next collateral branch, then it will be perceived that the truth of the second proposition above mentioned does not follow, because the absence of collateral vessels does not necessarily increase the extent of obliteration beyond certain limits, whilst in other respects it may prove injurious. I think it is not difficult to show that in vessels near the heart the risk of secondary hæmorrhage will be greater in an artery which gives off no collateral branches than in one which does, because, if these are not so near each other, or so near the place of ligature, as to interfere with the essential parts of the process of closure, they will be positively useful in breaking the direct force of the current of the circulation, and in obviating its impulse upon the deligated part of the artery. Perhaps my meaning will be better understood by referring to particular arteries. Let us, for example, compare the case of ligature of the common carotid artery with that of the external third of the subclavian. Here we have two vessels, both in the vicinity of the centre of the circulation, but I believe, *cæteris paribus*, that there will be less risk of secondary hæmorrhage in the case of the subclavian than in that of the carotid, because, in the former, there is sufficient space free from collateral branches to admit of the process of firm closure of the artery; in other words, there is as much space as nature generally uses for obliteration, whilst the direct aortic impulse on the deligated point and the newly formed structures is diminished just in proportion to the number and size of the branches given off from the subclavian on the cardiac side of the ligature. The current of blood passes into these branches, where it meets with no

resistance, instead of beating against the recent adhesions in the newly-obstructed part of the artery. The common carotid, on the other hand, presents an example of a long arterial tube giving off no collateral branches. In it therefore, when tied, the deligated point is exposed on its proximal aspect to the full and direct force of the cardiac impulse; whilst, on its distal side, it receives the collected force of the blood poured into it from the retrograde circulation through the various branches of the external and internal carotids and their anastomoses.

For these reasons, and from observation of the fact stated with reference to extent of obliteration, I have come to the conclusion—That, whilst a very short space between the collateral branches is unfavourable for ligature, a very long extent of artery without branches is not necessarily so favourable, in vessels near the heart, as a moderate space, say from an inch and a half to two inches, according to the size and position of the artery, with collateral branches on either side of the ligature; as the presence of these branches is useful in diverting the impulse of the circulation from the deligated point.

LECTURE LXII.

Changes in the Collateral Vessels and their Anastomoses after Ligature — The Apparent Formation of new Vessels in such Cases—Effects produced in neighbouring Structures by these Changes—Their accompanying Symptoms—Summary of the Effects of the Ligature.

One of the first effects of the ligature of an artery, and one which has been admitted by all investigators to be of constant occurrence, is the distension and enlargement of the collateral vessels and of all their anastomoses. This effect is easily explicable by mere physical laws, for it is obviously the result of the general law which regulates fluids—that they pass in the direction where there is least resistance. Hence, it is obvious that the current of blood propelled through the canal of an artery, when it meets with the complete obstruction caused by the constriction of the ligature, is of necessity forced upon the collateral vessels through their anastomoses with the artery tied, on the cardiac or proximal side of the ligature. As the pressure of the blood in these collateral vessels is equal in all their ramifications, the consequence is, that their branches which communicate with the artery on the distal side of the ligature also become distended, and empty themselves into the canal of the artery beyond the deligated point, thus indirectly re-establishing the circulation in it. But whilst the physical cause of this effect is evident and admitted by all, there are many points connected with it, and the uses which nature makes of this change for effecting the process of obliteration, and for carrying on the obstructed circulation by new channels, which are of great interest. I believe that its effects upon organs in the vicinity of the artery tied, will, if carefully examined, also serve to explain some phenomena occurring after the ligature of particular arteries which have been referred to other causes.

As I have already discussed the effect which this increased vascularity produces in the effusion of plastic lymph around the deligated part of the vessel, I shall not recur to that further, but restrict myself to the consideration of three points under this head—1*st*, The process of the re-establishment of the circulation as deduced from examination of the anastomoses at different periods after the application of the ligature. 2*d*, Whether these anastomoses are sufficient in all cases to effect such re-establishment, or whether in some cases new vessels of direct communication be not formed to supplement the existing anastomoses, as described by Dr. Parry and others. And 3*d*, The considera-

tion of the effect of the distension of the collateral branches and their ramifications on the neighbouring structures, as explaining, in some cases, symptoms of diseased action occurring after ligature.

As to the first of these questions, we find that the enlargement of the collateral vessels and their anastomoses differs much, both as to degree and general diffusion, according to the period after the operation at which we examine the parts concerned. If, for example, we dissect a carefully-injected preparation, say at the distance of a year or two after the arteries have been tied, we do not find any very unusual general vascularity. For the most part, we find only some of the greater and more direct inosculations considerably enlarged, and serving to keep up the circulation in parts beyond the deligated point. But such a dissection exhibits merely the result, not the phenomena of the gradual process by which that result has been accomplished; and to understand the gradual changes we must examine such preparations at different periods in the process.

When we examine the parts in the neighbourhood of an artery which has been recently tied, that is, during the first eight or nine days after the operation, we find all the tissues highly injected, and presenting the appearance of a network of turgid vessels. This vascularity is diffused over every part, and the more direct anastomoses, though distended in common with the rest, are by no means so much enlarged as we might be led to expect from examination of preparations made at a later period. This increase of the general vascularity is constant, and I have proved it not only by dissections of minutely-injected parts, but also by observing the great difference in the amount of bleeding which takes place on cutting down upon one carotid artery some days after the opposite vessel had been secured. In the normal state of parts there is scarcely any bleeding, whilst in the cases where one of the arteries has been previously tied, the general arterial hæmorrhage is very copious, and vessels of the skin and other tissues often bleed *per saltum.* At a later period, from the fourth to the eighth week, the vascularity becomes less general, and the more direct collateral inosculations are now found to be very considerably enlarged, sometimes to three or four times their natural size; whilst their parietes are tender, more easily torn, as if thinner in structure in consequence of distension. The vessels which are then principally enlarged are the primary and direct collateral arteries, and their anastomoses, and some of the secondary collateral inosculations, as those communicating with the vasa vasorum, and the neurilemmal vessels of the larger nerves accompanying the artery which has been tied, or existing in its immediate vicinity. At this period the circulation has been completely re-established, filling the tied vessel above and below the obliterated point; and, as I have elsewhere stated, not only beyond the collateral inosculations on either side, but also between them and the part tied, where there is a long portion of the artery without collateral branches. After a still greater lapse of time, the primary and direct anastomoses form generally the only remarkable vessels, and even they, I am led to believe, from my own observations and dissections, gradually decrease, with the exception of perhaps a few of the most direct. At least they certainly do not

increase in size after the eighth week; for in the preparations I have dissected at a considerable period after ligature, the anastomoses, with two or three exceptions, were not so large or numerous as in similar dissections where the animal had been killed at the end of six or eight weeks after the arteries had been tied.

The following appears to me to be the *rationale* of the facts I have just stated. By the sudden and complete obstruction of a large arterial trunk, the blood usually passing through it is forced upon the collateral vessels and their anastomoses. And as the more direct communications are not sufficient at first to carry the whole quantity back into its natural channel, the pressure of course forces it also into all the neighbouring vessels, and so gives rise to the general diffuse vascularity. Thus, not only is the circulation to the parts beyond the ligature provided for, but another purpose is fulfilled. The vitality of the arterial coats and of the tissues around the vessel is increased, and they are adapted both for resisting too rapid ulceration, and for furnishing new products necessary for the safe completion of the process of obliteration. When these first indications are fulfilled, and obliteration has taken place, diminished vascularity and absorption follow, and the office of carrying on the circulation is then performed by the larger and more direct anastomoses, which have gradually become sufficiently dilated for that purpose by the more direct pressure of the blood upon them.

Some investigators differ from these views, as regards the sufficiency of the existing collateral branches to re-establish the circulation in a large artery which has been tied. They consider that in such cases nature assists these existing vessels by the formation of new direct arterial communications between the cardiac and distal portions of the artery. This opinion is founded upon the appearance of short vessels passing directly from the point of the artery immediately below the obliteration, to the point immediately above it; and they reason that new vessels would not be created if the existing channels were sufficient for the purpose. As it has been proved repeatedly in the dead body, that, even with coarse injections, the existing anastomoses will serve to fill the distal portion of an artery which has been tied, I think it needless to insist on a fact so well demonstrated, further than to point out the source of the fallacy on which the opinion I have alluded to is founded. This I can do by showing that the supposed new vessels occasionally seen are in reality only portions of vessels previously existing, and it will be best done by tracing the manner in which this appearance occurs.

In dissecting one of my preparations after ligature of both vertebral and carotid arteries, I was struck by the appearance of one of these supposed new vessels arising from the lower portion of the left carotid just below the obliterated point, ascending parallel to it, and again terminating in it immediately above the obliteration, and having no apparent communication with any other vessel. I did not even then feel satisfied of its being a new formation, because I had noticed during the dissection that it passed upwards upon the vagus nerve, and hence, although I could trace no other branches communicating with it, I suspected it to be merely a portion of one of the vessels of the sheath.

That the opinion I then entertained was correct I have since had decisive proof. Before proceeding to dissect the anastomoses after ligature of both carotids in another case, I first threw in a very fine-coloured size-injection, which was followed up by one composed of wax and varnish, so as to insure the injection of the most minute inosculations. As I had anticipated, the real nature of the short communicating vessels between the ends of the obliterated artery was then very readily made out. On both sides of the neck in that preparation a branch of the ascending cervical artery was seen to pass upwards along the course of the vagus lying between it and the carotid artery, more closely attached to the nerve but sending off twigs to both. Immediately on the cardiac side of the obliteration there was a very large inosculation between this ascending vessel and the vasa vasorum, and a similar anastomosis occurred immediately above the obliteration, and then the ascending artery became much smaller, and was gradually lost upon the vagus. Now it appears to me pretty evident that if I had not taken the precaution I have mentioned, in injecting the vessels with size before throwing in the wax, the appearance would just have been similar to those in the former preparations. In other words, only the larger portion of this anastomosis would have been injected, and it would then have presented the appearance of a direct communication between the two portions of the carotid, and its connection with the ascending collateral branch would have been lost. Any one who compares the two preparations I have alluded to, or looks at plate xxiii. fig. 3, will have little difficulty in determining the true nature of these supposed new vessels described by Dr. Parry and others, and in coming to the same conclusion as I have done—That they are not new vessels, but merely portions of the enlarged inosculations of previously existing vessels of the sheath, with the vasa vasorum.

Lastly, we have to consider the effects which this alteration in the circulation produces upon organs in the vicinity of the obstructed artery, and the symptoms to which these effects may sometimes give rise. I have shown that, immediately after the application of the ligature, the blood which formerly passed through the obstructed vessel is thrown upon and distends all the vessels in the neighbourhood, thus giving rise to a great increase of vascularity in the surrounding textures, and consequently more or less affecting their functions. But of all the tissues, we find the nerves to be most affected by this increased vascularity. The vessels of the neurilemma and their ramifications amongst the fibrillæ of the nerves are generally very much distended from the first, and continue to be so for a very considerable period after obliteration has been accomplished and the general vascularity diminished. This is more especially the case with those nerves which are in immediate contact with and run parallel to an artery which has been tied. If we reflect for a moment, it must be evident that such distension of the neurilemmal vessels and increased vascularity of the nervous texture can scarcely fail to give rise to irritation and corresponding symptoms in the organs to which such nerves are distributed. To this cause the neuralgic pains which occur after ligature of the arteries of the extremities have long been very generally referred. But it is not a little sin-

gular that the influence of the same cause has been so little attended to with reference to nerves of special functions. I here particularly allude to the investigations into the causes of the symptoms and lesions so frequently noticed after ligature of the carotid arteries. From the time that operation has been practised, the very general, almost constant occurrence of cough and laryngeal irritation, or difficult deglutition, and not unfrequently pulmonary congestion, has drawn the attention of surgeons to this subject. The late Sir Charles Bell supposed that the sense of constriction and suffocation sometimes felt arose from an increase of the aneurismal swelling during the first days after the operation. But this could not account for these symptoms, as they occurred in cases where the artery had been tied for other causes.

Next, an opinion was pretty generally entertained that, in consequence of the irregularity of the cerebral circulation after ligature of the carotid, the functions of the brain were disordered, and that the respiration was affected secondarily through the medium of the pneumogastric nerve. But why, Professor Miller has well observed, that unfortunate nerve should have been singled out as the representative of the general cerebral irregularity, was never very clearly explained.

Of late years attention has been again directed to this subject by the researches of M. Robert (de Lamballe), and also by the late Professor Miller of this university.

M. Robert found in the experiments he performed that the most frequent lesion was pulmonary congestion, and he inferred that this results from the lost balance of circulation consequent upon the obstruction of these large vessels in the immediate vicinity of the heart. Professor Miller coincides with M. Robert's views.

Now, whilst I am not disposed to deny that the cause assigned by M. Robert and Professor Miller may, to a certain extent, influence the propagation of these symptoms, I cannot admit it as being the only or the primary one. Otherwise, we ought to meet with the same symptoms as frequently after ligature of the subclavian as of the carotid; and, indeed, in some degree, after the ligature of every large vessel; for in all such operations the general circulation is affected. I think that these gentlemen have overlooked the first link in the chain of diseased action, the source of direct irritation. In short, I believe all the symptoms of laryngeal, bronchial, and pulmonary irritation, after ligature of the carotid, may be accounted for, in the first instance, by reference to the same law of nervous irritation which has been so generally acknowledged in regard to the painful symptoms in the extremities after ligature. This arises in consequence of the increased vascularity of the nervous structure and distension of the vessels of the neurilemma. And when we reflect upon the close proximity of the pneumo-gastric to the carotid artery, the great increase of vascularity which it exhibits, and the pressure of the plastic effusion upon it after the application of the ligature, we may easily comprehend how these will act as a source of direct irritation to that important nerve, deranging its functions, and giving rise to symptoms of irritation or disease in the respiratory organs to which it is distributed.

As to the pathological conditions found in the cases examined by

M. Robert and others, we must bear in mind that different causes may produce the same effect. Of one thing at least I am quite sure, from considerable practice in experiments upon the pneumo-gastric—namely, that all the symptoms and pulmonary lesions described by M. Robert are produced with equal certainty by irritation or injury of that nerve as they could possibly be by the cause he has assigned. Whilst the ligature of other arteries equally deranging the circulation, but more remote from the pneumo-gastric nerve, are not so generally attended with these symptoms of disordered respiration.

Having thus concluded my remarks on the special parts of the process, I shall give a summary of what I hold to be the essential effects of the ligature of an artery, according to the results of my experiments. 1*st*, It divides the two internal coats, which retract, and are puckered inwards. It constricts, without breaking, the cellular coat, so as to completely prevent the circulation through the vessel, the blood previously flowing through being determined on the collateral branches, which become enlarged. 2*d*, Plastic lymph is effused on the exterior and interior of the vessel tied. In the interior, between the cut edges of the internal coats, and also on their internal surface, for some distance on each side of the ligature, uniting these coats, and forming an internal mass of plastic organisable lymph; on the exterior of the vessel, compressing it in the vicinity of the ligature, acting as a medium of nutrition, gradually consolidating round the artery, contracting closer adhesions to and ultimately becoming incorporated with its external coat, filling up the groove formed by the thread, and following in the track of the ligature as it ulcerates through the part upon which it is immediately applied. This external effusion of plastic lymph unites the ends of the artery divided by the ulcerative process, and supports the internal plastic coagulum and its adhesions at the period of the separation of the ligature. It becomes blended with it, being gradually diminished in bulk and altered in structure, so as ultimately to become an impervious fibrous cord. 3*d*, The ligature causes complete obliteration of the vessel at the point tied, and for some distance above and below that point, such obliteration never passing beyond the nearest collateral branch, but not necessarily extending up to the nearest collateral branches, if these are remote from the point tied—the whole space of the vessel, which is completely obliterated, seldom exceeding an inch and a half or two inches, although there may exist no collateral branches to oppose its further obliteration. 4*th*, It causes enlargement of all the collateral branches in the first instance, by which two purposes are effected :—The circulation formerly carried on through the tied vessel to the parts beyond the ligature is then carried on by the anastomoses of its various collateral branches, and so re-established. The vessels of the sheath and vasa vasorum also become enlarged, increase the vitality of the arterial coats, and adapt them for the changes requisite for safe obliteration. Subsequently the smaller vessels contract, and resume their natural size and functions, whilst the circulation is re-established in the main trunk, principally by the anastomoses between some of the larger collateral branches.

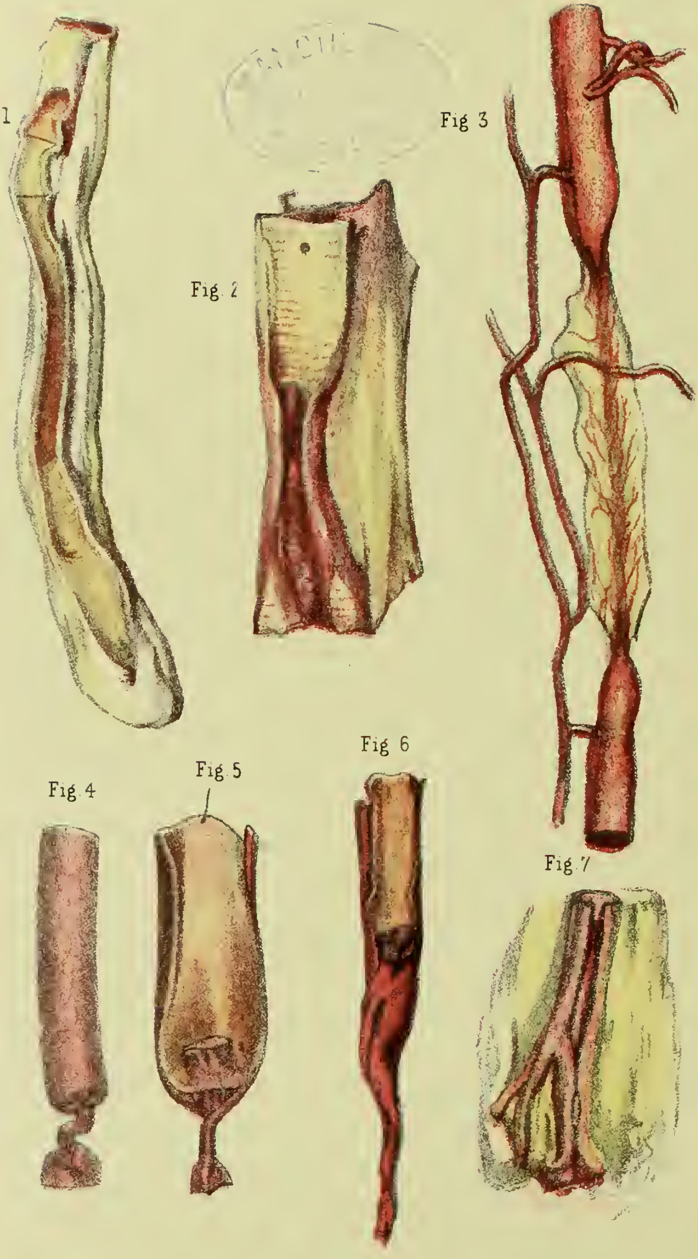


Fig 1
Fig. 2
Fig 3
Fig. 4
Fig. 5
Fig 6
Fig. 7

LECTURE LXIII.

Torsion—Principle on which it is founded first introduced by M. Amussat—His Method of operating recently revived as a Substitute for the Ligature—Acupressure as introduced by Sir J. Y. Simpson—Different Methods—Wire Compress. Consecutive Hæmorrhage: Reactionary and Secondary—Causes and Treatment.

Torsion as a means of arresting hæmorrhage, is founded on the observation of the natural hæmostatic process, which prevents bleeding from contused or torn arteries, and to which I have already adverted. The method, as the name implies, consists in imitating the accidental occurrence, by artificially twisting the vessel after it has been drawn out from the surrounding parts. M. Amussat was the first who tried to introduce torsion as a general method to be applied to all arteries divided in operations, and laid down certain principles on which it should be performed. A very obvious objection to the method was, that in drawing out the artery from the surrounding tissues, and twisting it so as to rupture its inner coats, the tractile and twisting force employed was likely to separate the vascular connections of the artery with its sheath, consequently to impair its vitality, and lead to sloughing and secondary hæmorrhage. To obviate this risk, M. Amussat used two pairs of forceps—one pair with sharply grooved points to seize and twist the vessel, whilst with other forceps which had flat smooth blades, he fixed the artery close to the soft parts so as to prevent the act of torsion affecting the vessel beyond. The effect produced by this plan is not always exactly the same, but, as a general rule, the two internal coats are ruptured, and more or less inverted, so as to project into the canal of the vessel, whilst the external coat is twisted so as to form a mechanical obstacle to the escape of blood, as represented in (plate xxiii. figs. 4 and 5); fig. 6 of the same plate represents a very good example of natural torsion of the brachial artery from a case of injury by machinery, in which I amputated at the shoulder-joint.

Torsion has recently been revived, and attempted to be re-introduced as a substitute for the ligature or acupressure. It answers well enough for small vessels, and I frequently use it. Past experience, however, has shewn that we cannot safely trust to it in the larger arteries. In the present day the twisting is continued till the twisted portion comes off. This is done to avoid leaving that portion in the wound, as it is almost certain to die and act as a foreign body, or, what is worse, to serve as a centre of unhealthy action. But were this done in the larger vessels, the condition of the inner coats is too uncertain

to trust to for arrestment of bleeding. Torsion answers well enough in some cases, and may occasionally be used with advantage; but, as a general plan, it is far inferior either to the ligature or acupressure.

The most recent mode of effecting the occlusion of arteries and the arrestment of hæmorrhage, is that devised by the late Sir James Simpson, and followed out by him with his usual energy and ability. I allude to the method of acupressure.

ACUPRESSURE aims at securing the mouths of the divided and bleeding artery by thrusting a needle through the tissues across the course of an artery, under or over it as the case may be, so that, whilst the needle presses on one side, the resisting tissues on the opposite side exercise counter-pressure. Or direct firm counter-pressure may be made by means of a looped wire passed over the point of the needle, across the course of the vessel, then bent round the needle, and twisted so as to lie parallel to it. The advantages claimed for it are numerous. It is elegant, expeditious, cleanly, and efficient. The needle can be easily introduced and readily withdrawn. It need not therefore lodge in the tissues so long as to produce irritation in them. A strong point in the case, and one of which Sir James has evidently taken advantage, is, that the tissues have a far greater tolerance of metallic than of organic substances, however well the latter may be protected by antiseptic or other agencies. One thing is certain, that if the hæmostatic mechanism, of whatever kind it is, can with safety be withdrawn within twenty-four, forty-eight, or seventy-two hours, a great source of anxiety will be got rid of, and the result will be speedy compared with the slow process by which the ligature ulcerates its way towards final separation.

There are seven or eight prescribed methods of applying acupressure, some four of which are usually practised. Three of these are modifications of the direct or Edinburgh mode; the fourth, and perhaps the most useful for small vessels, is the indirect or Aberdeen twist. The principle of the Edinburgh plan is to insert the needle into the tissues, on the near side of the artery, causing its point to emerge close to the side of the vessel, and insert it again into the tissues on the opposite side. This makes it bridge over the artery—so compressing it. Thus, its course is at right angles to the artery, and it runs straight across. The Aberdeen plan consists in inserting the needle in a line parallel to the artery, then twisting it round until it traverses either a quarter or half circle, as the case may be, then re-introducing it firmly into the tissues. This compression is effected, partly by direct pressure with the needle on the artery, and partly by the tension and resistance of the twisted tissues.

For fuller details regarding this subject, I cannot do better than refer you to Sir James Simpson's original work on acupressure, or to the recent treatise by Messrs. Pirrie and Keith, Aberdeen.

In my own practice I have not yet used acupressure to such an extent as to enable me to speak authoritatively of its advantages or disadvantages. In arresting bleeding from small vessels after the removal of tumours, it can be used with perfect safety, and with the advantage of easy removal of the needle in a short time; and in wounded

arteries, such as the radial or ulnar, or even the brachial, I would have little hesitation in trusting to it. I have used it with advantage to compress the vessels of the cord in castration, as it not only arrests the bleeding, both temporarily and definitely, but also effectually prevents all risk of the cord, or vessels of the cord, being retracted within the canal; a risk, however, which is much more imaginary than real. I have also used it in amputations at the ankle; and on three occasions advantageously, to compress the facial below the lower jaw, in cases of removal of tumours of the upper jaw. In the greater amputations I have not tried it, partly because I have found the ligature answer very well, and I am by no means satisfied of the evils said to be induced by it, but chifly because my experience of the gradual manner in which the hæmostatic process is effected after ligature of an artery, and a consideration of the unfortunate results which followed the attempts of Travers and others to remove the ligature at the expiry of twenty-four or forty-eight hours, have prevented me feeling that confidence which I should desire to have against the risk of hæmorrhage occurring from a large artery on withdrawing the needle at a very early period. At the same time there are some points of difference. The withdrawal of the needle is effected much more easily and with less disturbance of parts than that of a ligature could be. The hæmostatic process would likewise seem to be somewhat different. In a specimen of the brachial artery, for which I am indebted to the politeness of Mr. Lawson Tait of Wakefield, amputation of the arm had been performed under very unfavourable circumstances. Mr. Tait used acupressure by the needle and looped wire method; the man sank in thirty-eight hours after the operation. On examining the portion of artery sent me, and which is represented in plate xxiii. fig. 7, I found a delicate blood-clot slightly adherent to the arterial wall. This, however, as might have been expected, was not resistent enough to have prevented hæmorrhage; but at the point of acupressure, and for a short distance on either side, the vessel was firmly occluded by plastic lymph, and there seemed no division of the inner coats of the artery. In ligature, no plastic material is thrown out at the point of deligation, *i.e.* immediately under the constricting ligature; the plastic process takes place on either side of the ligature, or in an artery divided, as in amputation, immediately above the point of constriction. So far as I can judge from this specimen, the vitality of the part even directly compressed does not necessarily suffer, and consequently plastic changes go on there, and a continuous lymph-plug seems to be rapidly formed and organised. I think, however, that it would be very desirable to have experiments performed, so that the principle of the hæmostatic process, as effected by acupressure, and the differences between its action and that of the ligature, might be thoroughly investigated, as otherwise, notwithstanding the success which seems to have attended its use by some, there must always remain lurking in the minds of surgeons doubts as to the risks of hæmorrhage, and a want of confidence which will prevent its general use.

When employed instead of the ligature, in the case of a continuous artery, as in an aneurism, I must say that I consider acupressure un-

suitable, because, when the vessel is deeply seated, the needle would require to be not an ordinary acupressure-needle, but one with a curve, and it is excessively difficult, almost impossible, to withdraw such a needle from a deeply-placed artery, such as the carotid, subclavian, or innominate, without great disturbance of parts.

These difficulties, as regards its application to deep-seated continuous arteries, I have tested on the dead subject, and they would be still greater in the living body.

As to my own practice, I have already said that I do not consider the benefits of acupressure so decided as to lead me to adopt it, as a general method, as a substitute for the ligature.

The WIRE-COMPRESS, a modification of acupressure, has been used, and with some success, even in securing the carotid artery. It consists in passing a wire instead of a thread under the artery. The ends of the wire are brought up, and the wound is closed. On the surface of the wound a piece of cork is placed, and the ends of the wire are tied over the cork, so as to make it press downwards towards the deeper parts. The wire is tightened till the circulation is completely stopped, and the cork is then fastened down with strips of plaster. This plan seems to have answered very well in some cases, and I once entertained great hopes of its success; but there are dangers connected with it. It does not always prevent suppuration, even after the wire has been withdrawn, for abscesses sometimes form where the wire had been, and I have known secondary hæmorrhage occur, and therefore I still think that the small round ligature is preferable to acupressure or the wire-compress in arresting the flow of blood, at all events through a continuous artery.

CONSECUTIVE HÆMORRHAGE arises in two forms, *Reactionary* and *Secondary*. The term SECONDARY HÆMORRHAGE is used to denote the bleeding which sometimes supervenes from the failure of hæmostatic measures, as when it occurs from rapid ulceration of the artery after ligature, before the hæmostatic process has been completed. It is also applied by some to the bleeding which occurs some hours after an operation, from vessels which had not been secured. I think it is better to distinguish the latter form of bleeding by the term REACTIONARY Hæmorrhage as implying its cause, in contradistinction to the various conditions which lead to secondary hæmorrhage proper.

REACTIONARY HÆMORRHAGE arises from small vessels, which, owing to the depressed state of the circulation during and immediately after an operation, do not bleed at the time, and consequently are left unsecured because unperceived. So soon, however, as reaction sets in, and the circulation becomes excited, bleeding from these branches begins. The wound becomes distended with coagula, which tend to keep up the bleeding, and this, unless interfered with, may lead to serious results. In this form of hæmorrhage the knowledge of the cause indicates the proper treatment—namely, to open the wound, clear out coagula, and sponge the surface with warm water, so as to detect and secure the bleeding vessels. In many cases when the clots have been removed, and the cut surface exposed, no bleeding vessels can be

seen, the oozing of blood gradually ceases, and nothing more requires to be done. It is not, however, safe to trust altogether to this temporary cessation of the bleeding, for that may be the result of the depression induced by loss of blood, and the hæmorrhage might recommence when reaction again took place. The proper plan under such circumstances is to give the patient some slight stimulant to rouse the force of the circulation, apply a sponge wrung out of warm water to the bleeding surface, cover up the patient with the bedclothes, and wait for a short time to see whether any further bleeding occurs. If it does, the vessel or vessels can then be seen and secured; if not, the wound is left open so as to prevent coagula collecting, and an assistant should be left for a few hours to watch until the cut surface becomes glazed and dry, then the wound may be finally closed without risk of further bleeding.

The causes of true SECONDARY HÆMORRHAGE have been already in a great measure discussed. They are of two kinds: *First,* those which to a certain extent are preventable by care on the part of the surgeon, and by proper treatment. *Second,* those which are unavoidable, when unfavourable local or constitutional conditions are present. In tying an artery I have shown you that certain points are to be attended to which are of great importance. It is not merely the cutting down upon the artery to expose it that is important; we should endeavour to disturb the connections of the vessel as little as possible. We have seen that the coats of the artery are nourished chiefly by the vasa vasorum, which connect the coats of the vessel to the cellular sheath surrounding it; and if we disturb these very much, either by traction on the vessel, or by too much force in introducing the needle, or by dissecting and insulating the artery too much, we do harm. We should only separate the vessel from its sheath so far as to allow the aneurism-needle to be passed easily round it; but in doing this no force should be used, and the needle should be passed close to the coats of the artery. By paying attention to these details, the surgeon does all he can to prevent secondary hæmorrhage, the great point being to disturb the vessel as little as possible.

The second class of cases are those in which the prevention of secondary hæmorrhage is not so directly under our control. Such, for example, as those depending on the state of the patient's health, or that of the arterial texture; conditions which have a great tendency to produce secondary hæmorrhage. In some cases, as after amputation —more especially after primary amputation—secondary hæmorrhage may take place from sloughing of the surrounding textures, leading to ulceration of the vessel even above the ligatured point. Again, in a very large number of cases, where secondary hæmorrhage does occur after amputation, it is associated with pyæmia, or some blood-disease, as in cases of malignant growths, circumstances under which all the plastic changes are more or less interfered with; these unfavourable conditions cannot be obviated by the surgeon. All that we can do here to prevent secondary hæmorrhage is to use great care in the application of the ligature, and to attend afterwards to the nutrition of the patient, giving nourishing but not stimulating diet, and avoiding

for some time after the operation anything likely to over-stimulate the circulation. Antimonials and low diet used to be prescribed to diminish the force of the circulation; but, for reasons I have already adduced, I think this a bad plan, as it tends to prevent healthy plastic changes going on. The best treatment is to keep the patient perfectly quiet, give nourishing diet, and apply only very light or antiseptic dressings to the wound.

The treatment of secondary hæmorrhage will depend in some measure on the nature of the case in which it occurs, and the state of the vessel and surrounding parts. When it arises after wounds, or such operations as amputations, resections, or removal of tumours, if the bleeding be not very profuse, the clearing out of coagula and properly applied compression, or the application of cold, may prove sufficient to arrest it. But if the condition be urgent, either from the rapid loss of blood indicating that its source is some large vessel, or from the debilitated state of the patient rendering loss even of a small quantity of blood dangerous, then no time should be lost in taking decided measures. The stump or wound should be opened after the main vessel has been compressed higher up, and all coagula cleared out, so that we may see what vessel is the source of hæmorrhage. This appears to me the only safe plan; all temporising measures are dangerous. In cases of amputation it used to be advised to tie the main trunk higher in the limb without opening up the stump. In some few cases this may be necessary, owing to the stump; but direct ligature or acupressure of the affected vessel is generally the safest. Besides, we cannot be quite sure whether the main artery or arteries are the sources of the bleeding.

I recollect, several years ago, being called to the hospital, in consequence of the occurrence of secondary hæmorrhage from the stump of a thigh which was nearly healed, and from which the ligatures had separated, without any bleeding, some time previously. I was unwilling to open up the recently united parts; and, as the bleeding had been rapid, I concluded it must be from the femoral, and thought it would be better to tie the femoral in Scarpa's triangle. On second thoughts, however, I determined to open up the stump. There was no bleeding from the position of the femoral, but there was a very minute portion of the femur necrosed and separated. The surrounding periosteum was thick and vascular, and one large periosteal artery, opened by the ulcerative process, was seen pumping out blood freely, although the femoral was compressed in the thigh. No other vessel required ligature; the small scale of bone was removed, and the stump healed very rapidly. In this case the proposed operation was not only unnecessary, but, had I tied the femoral high up, I doubt if it would have effectually arrested the bleeding from the periosteal vessel. Recently, in another private case, in which I had amputated the thigh high up, for a malignant vascular tumour of the condyle, secondary bleeding, to an alarming extent, took place about the tenth day. The bleeding was promptly arrested by the patient's medical attendant, who lived near him. On visiting him I found him blanched and faint,

and the state of the bed-clothes showed that the loss of blood had been serious. A tourniquet was applied, the stump opened, the clots cleared out, and the surfaces sponged with warm water, but no bleeding point could be observed. The ligature had separated from the femoral artery, but there was no clot at that part of the stump; and when the tourniquet was slackened, the artery could be felt and seen pulsating, but not a drop of blood escaped there. Stimulants were given to excite the force of the circulation, but still no source of the hæmorrhage could be detected, and, after waiting for some time, I closed the stump and applied a bandage. No further bleeding or oozing occurred, and the patient made a good recovery. What the cause of bleeding may have been I cannot conjecture, unless it were from the medullary canal of the femur; but the absence of any indication of the source of the hæmorrhage made me all the more anxious about the case. In cases where you find that the bleeding proceeds from one of the larger vessels in a stump or operation wound, the best plan is to clear the artery higher up, and tie it at a healthy part. In cases where the coats of the vessel are in a doubtful state, or the surface of the wound in its vicinity unhealthy, acupressure by the long needle and looped wire, applied across the course of the vessel higher up, should be tried, in preference to much dissection of the parts, or before we tie the main trunk higher up in the limb.

In cases of secondary bleeding from small vessels—as after excision of tumours—acupressure or compression, or touching the bleeding point with perchloride of iron, solution of chloride of zinc, or spirit of turpentine, is generally sufficient for the purpose of stopping it.

When secondary hæmorrhage follows ligature of a continuous artery—as in cases of deligation for aneurism—it is very serious, and our measures must be prompt. Compression should be made on the trunk of the artery nearer the heart, to command the bleeding, the wound opened out, clots removed, and the artery cleared and tied above and below the ulcerated point. This is absolutely necessary in the first instance. Whether we may require to tie the vessel at a different part of its course, much nearer the heart, will depend on circumstances, such as the state of the vessel—that being so altered as not to be likely to withstand the action of the ligature till permanent hæmostatic changes have occurred—or the soft parts around the vessel being so injured that sloughing and recurrence of bleeding are likely to take place. I have already alluded to a case of ligature of the axillary for bleeding from the brachial in a burn of the arm. This example will be found in the Clinical Cases * appended to this section. In all cases the bleeding point must be secured above and below, by ligatures or needles.

In some cases, from peculiar circumstances, amputation may become imperative. We must not, however, proceed to heroic measures too hurriedly. I have known slight bleeding occur in a case of ligature of the femoral some days after the ligature had separated, in which, by

* Clinical Cases, vol. ii., after Special Aneurisms and Ligature of Arteries.

leaving the wound exposed without compression, the hæmorrhage ceased, and never recurred (see Clinical Cases *). In cases where arteries are opened into by diseased action of the neighbouring textures, it is often impossible to detect the bleeding point, even though we may suspect it. In these cases we must trust to pressure, or, if that cannot be borne, then we must tie the arterial trunk higher up. This may suffice; but it may fail, as in the case of Mr. A. T., recorded in the Clinical Cases.

* Clinical Cases, vol. ii., after Special Aneurisms and Ligature of Arteries.

LECTURE LXIV.

Diseases of Arteries—Arteritis—Fatty, Calcareous, and Waxy Degenerations: Processes and Laws by which they conduce to Lesions of the Bloodvessels—Aneurism: True and False; Definition and Classification—Varieties of Aneurism: Dissecting, Fusiform, and Sacculated Forms; their Physiological and Pathological Tendencies and Terminations.

As I have now described at some length the injuries of arteries, and natural and artificial hæmostatics, I proceed to bring before you the diseases of the arterial system and their treatment.

Acute arteritis is a disease, the existence of which is still problematical. In the neighbourhood of wounds, or other sources of irritation, limited portions of the arterial walls may present the usual appearances of inflammatory action, such as depositions of pus or plastic lymph within their tissues; but, as to the existence of general or extensive inflammation of the arterial coats, arising from ordinary idiopathic or constitutional causes, pathologists are not yet agreed. There is the same doubt regarding the existence of any general chronic arteritis of a simple nature, though it is becoming more and more probable that irritative action, partaking somewhat of the inflammatory character, is closely connected with the production of certain of those degenerative changes, the evidences of which are found so commonly in the walls of arteries on *post-mortem* examination.

These degenerations, which are important to the surgeon as well as the physician, are three in number—namely, the fatty, the calcareous, and the waxy,—the first two being closely connected in their nature and mode of origin. We need say little about the waxy, as it comes more especially within the province of the physician. It is a disease very frequently found in association with the syphilitic or other wasting dyscrasiæ, affecting not only the whole of the vascular system, but also the various organs of the body, more especially the liver and kidneys. It produces a thickening, and consequent diminution of elasticity, in the walls of the vessels; and, when attacking the liver or kidneys, its advanced stage is marked by the deposition within the cells and intervascular spaces of a homogeneous substance, the accumulation of which enlarges the organ, and gives its section a semi-translucent, waxy, or lardaceous appearance, from which the disease has derived its various names.

The fatty and calcareous degenerations are essentially diseases of advanced life, their traces being found almost universally in greater or less degree within the arterial walls of old people after death. They are, however, met with very frequently in middle life, and they may be noted from time to time even in the comparatively young. The *post-*

mortem appearances of an artery which has undergone this form of degeneration are very characteristic. Its coats have a thickened, leathery appearance, due to degenerative changes having occurred more or less throughout all its tissues; and, if the vessel be slit open, well-marked patches, of varying size, and of greyish-yellow colour, will be found scattered over its inner surface. These are called atheromata. They are depôts of fatty *debris*, the product of degeneration, collected under the inner serous lining of the vessel; and if one of them be cut open, its cheesy contents will be found, with the aid of the microscope, to consist of a great quantity of fatty molecules, intermixed with scales of cholesterine, and a varying number of granular masses, composed of the carbonate and phosphate of lime, which effervesce on the addition of an acid. Deposits of pure earthy matter may alternate with the atheromatous patches, and in many cases they are exceedingly marked, whole arteries becoming converted into bony canals, quite devoid of elasticity, and much diminished in calibre. The part supplied by such a vessel necessarily suffers in its vitality, and, as was explained when considering that subject, gangrene not unfrequently results, especially the dry form of it known as *gangrena senilis*.

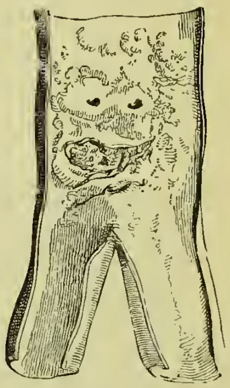


Fig. 79.

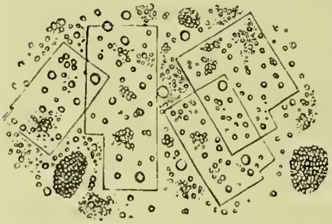


Fig. 80.

The tendency of an atheromatous deposit is to go on accumulating, until, having reached a certain size, its lining membrane is attacked by a species of ulceration which presently allows the escape of the atheromatous matter into the current of the blood. A cavity is thus formed, which is called an atheromatous ulcer. It may penetrate only through the serous lining, but in the majority of cases it also involves the middle coat, and, in a degree corresponding to its depth, it weakens the wall of the vessel, which at this point becomes very liable to be affected with aneurism.

Prior to the occurrence of calcareous or atheromatous deposit, pathologists now recognise a stage of inflammatory action, more or less chronic in its nature, which is important as regards the causation of the disease, it being precisely in those localities most subject to irritation of various kinds that degeneration of the vessel and aneurism are most likely to occur. For example, in certain cases we find that the atheromatous deposit arises at some point where there is a considerable amount of force affecting the vessel, as at the arch of the aorta, which meets with the first full impulse of the blood coming from the heart. In health, this impulse is met by the resistance of the elastic and muscular coats, but when degeneration has occurred, these ultimately yield from

Fig. 79. Artery opened, showing the atheromatous patches.
Fig. 80. Microscopical appearances of debris of atheromatous patch.

the constant strain upon them. Again, near the bifurcation of a vessel where it is becoming thinner, and where the blood meets with a slight interruption to its equable flow, we find that there is often a tendency to the production of aneurismal dilatation. Opposite any joint, also, which is much used, as in the popliteal space behind the knee, disease of the arterial trunk is very likely to occur. Thus, before the days of railway travelling, post-boys used to be very frequent subjects of popliteal aneurism; and now this form of disease is chiefly met with in persons who, from their occupation, constantly employ the knee-joint. For the same reason, all athletic exercises, if excessively indulged in, have a like tendency. After a certain period of life—say about forty or fifty years of age—if an individual continue to addict himself to such pursuits with the same ardour as in his youth, his muscular force being perhaps as strong as ever, he is not unlikely to have an aneurism, because the arterial coats may have been slowly degenerating with advancing years, so as to be now unable to resist the additional strain put upon them by the muscular exercise. Mr. Liston long ago drew special attention to this fact, and his own case unfortunately illustrated too well the truth of his observations. There are other conditions, such as dissipated habits, which lead to arterial disease and the formation of aneurisms; and the existence of the syphilitic cachexia is thought by many authorities to act very powerfully as a predisposing cause.

An Aneurism may be defined as a tumour containing fluid or coagulated blood, situated upon an artery, and communicating directly with its canal. Pulsation is a symptom almost invariably present. A sanguineous swelling, such as a thrombus, though it may be situated on an artery, is not an aneurism, because its cavity does not communicate with the canal of the artery. The above definition includes all forms of aneurism, both true and false. Under the head of *True Aneurism* I would class all *aneurisms arising from disease* of the arterial texture, whether the diseased condition be a degeneration and dilatation of all the coats of the vessel, or an ulceration of one or more of them, leading to dilatation of the external or fibrous coat. The existence of arterial disease is the essential character of a true aneurism as distinguished from a false; and it is that which indicates the great practical difference in the mode of treatment. The circumscription of the aneurism by a sac, derived from one or more of the arterial coats, is another character of true aneurism always present in its earlier stages, but it is not so important in a practical point of view as the diseased condition of the coats of the vessel.

A False Aneurism is nothing more or less than a wounded artery, the blood, prevented from escaping externally, being coagulated in the cellular tissue, which becomes condensed, and forms a sort of cyst, though generally a very imperfect one, as in some cases the force of the blood-current dissects the textures widely. The wound in the artery remains open, and enlarges by degrees, so that pulsation is in this case also a marked feature of the tumour. The coats of the vessel in this instance may be perfectly healthy; and, accordingly, we can treat it just as we would a wounded artery—namely, by laying open the sac, and tying the vessel above and below the wounded point. A diffuse

aneurism, resulting from rupture of a true aneurismal sac, should be regarded as the last stage of a true, and not be classified as a false aneurism.

There are several varieties of true aneurism. All, with one exception, tend to produce well-marked, rounded tumours, the exception being the form called "*The Dissecting Aneurism*," in which, though there is some amount of swelling in the course of the vessel at the point affected, we can scarcely say it is sufficient to constitute a tumour (plate xxiv. figs. 3 and 5). From rupture of the circular muscular fibres of the arterial coat, or from the atheromatous and calcareous ulceration already alluded to, the blood in this variety escapes outwards, and burrows beneath the external coat, separating it from the middle, so as to form a cavity, which may extend for a considerable distance in the course of the vessel, and involve more or less of its circumference. This is, however, a form rarely met with except in the aorta. I have seen only one instance of it elsewhere—namely, in the common iliac artery (plate xxiv. fig. 5). The direction of the burrowing action is generally from above downwards—that is, towards the extremities—though it may occasionally proceed in an upward direction, or towards the heart, as in the case of the common iliac artery just alluded to, where its downward course was obstructed.

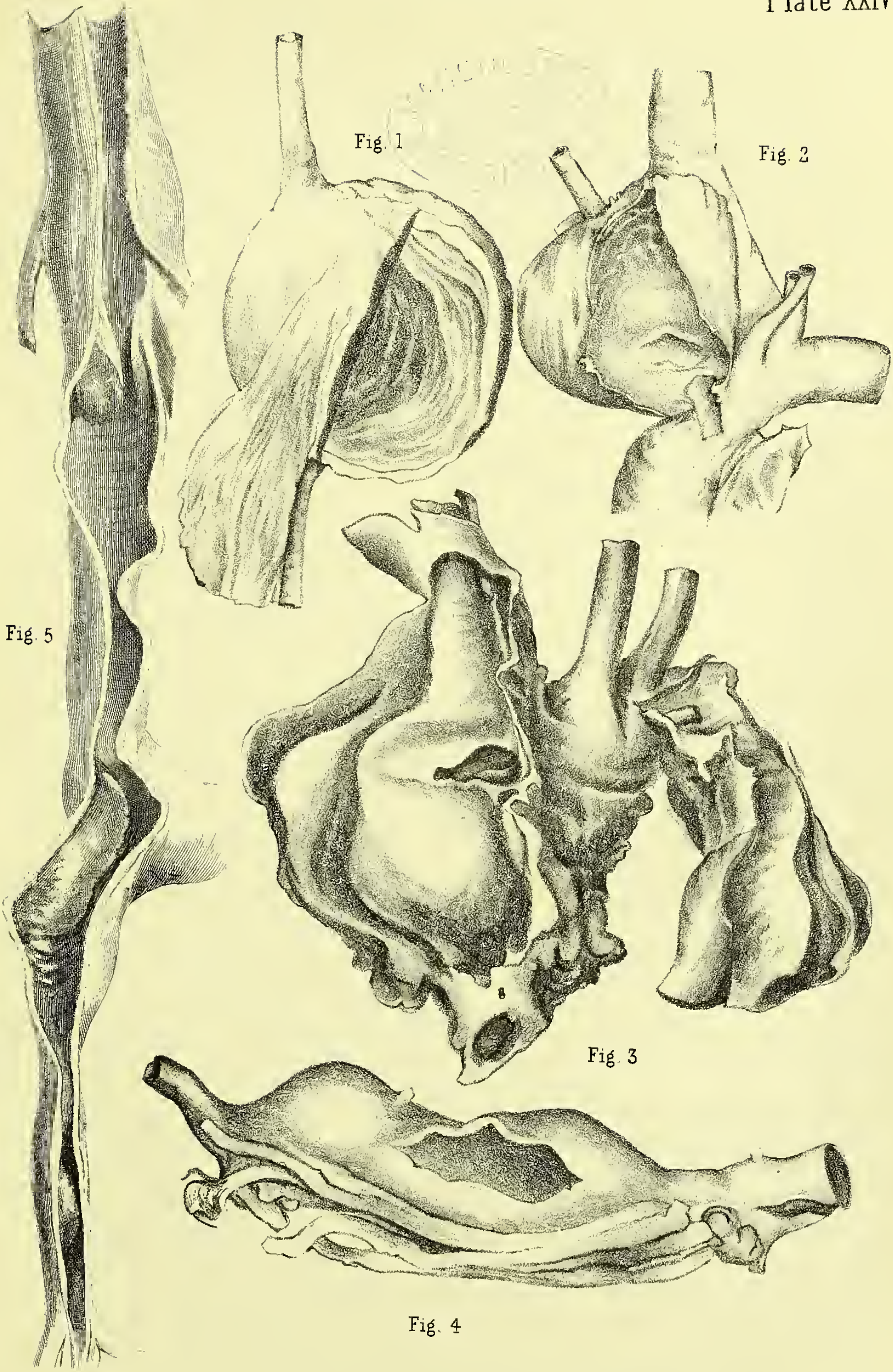
The ordinary True Aneurisms may be divided into two classes—

(*a*) The Fusiform (Scarpa's True Aneurism), in which we find dilatation of all the coats of the artery, arising from fatty disease of one or more of them—generally of them all (plate xxiv. fig. 4).

(*b*) The Lateral or Sacculated True Aneurism, where there is ulceration of the middle and internal coats of the vessel, and gradual dilatation and bulging of the external fibro-cellular coat (plate xxiv. fig. 2).

In the Fusiform Variety the diseased condition of the artery is that of general fatty degeneration, which soon causes it to lose its elasticity and power of reacting upon and propelling the blood. It therefore gives way before the pressure of its contents, and at the weakest part a dilatation takes place, which gradually assumes an ovoid or fusiform shape. By-and-by the internal lining coat of the artery becomes roughened by little masses of atheromatous and calcareous deposit, which form beneath it, and in course of time give a coarse granular appearance to the interior of the sac. This is generally a very unfavourable form of aneurism, for there is in most cases the same diseased condition which produced it existing throughout the whole arterial system, though to a less extent than in the particular artery affected. The following points are important as characteristic of this variety;—the vessel dilates with comparative slowness; the aneurism is, as a rule, easily emptied of its contents by pressure; the pulsation is very distinct and very equal; and there is present in it a *bruit* of a peculiar kind, different from that heard in other varieties; the vessel above and below the dilated point is generally thickened, but is still able to react upon the blood passing through it; the lining membrane is in the first instance smooth, and the tendency of the blood to coagulate on its surface is small, for the cavity is not very much dilated, and the current of blood passes through it in a direct and continuous stream.

Plate XXIV



Waterston & Son Edin Lith

In the Lateral or Sacculated True Aneurism we have ulceration of the two internal coats of the artery, and gradual dilatation of the outer or fibro-cellular coat. This aneurism generally arises from some atheromatous or earthy deposit taking place between the internal and middle coats of the vessel, which leads to irritation of the part, and ultimately, as already described, to ulceration. Probably the increased amount of friction from the current of blood to which the atheromatous patch is exposed may be one of the causes leading to ulceration of its lining membrane, for the inner coat of the vessel is raised and roughened by the atheromatous deposit, and the blood rushing continually over such a surface will naturally produce some degree of irritation. In this aneurism the vessel does not dilate in its whole circumference equally, as in the ovoid variety, but it slowly projects the external coat at the seat of the atheromatous ulcer, till it forms a round or sometimes ovoid-looking swelling upon the *side* of the vessel. It may grow to a great size—the opening of communication with the vessel slowly increasing with the growth of the sac.

These are the forms of true aneurism, and in each of them it will be observed the two essential characters are present, namely, a diseased state of the arterial texture, and a sac formed by the dilatation of one or more of the arterial coats.

There are certain *tendencies* in true aneurism which must be noticed, as they serve as indications in the treatment of the disease. Of the greatest importance is the tendency to coagulation within the sac. This varies in intensity according to the degree of stagnation, being greatest in the saccular form (plate xxiv. fig. 2), where the cavity of the sac is, as it were, withdrawn from the vascular current, and, for the opposite reason, least in the fusiform. As the coagulation advances, changes take place in the collateral circulation. The presence of an aneurism, even though there be a free channel through it for the blood, is always a cause of more or less retardation to the local circulation, the normal resiliency of the vascular walls being lost at the seat of disease. Meeting with such an obstruction, the blood is more and more diverted into the collateral branches which arise from the main trunk on the proximal side of the aneurism, and these, to meet the exigency, become slowly and gradually enlarged. These two processes, —coagulation within the sac, and gradual diversion of the current of blood to the collateral circulation,—may steadily proceed, until the blood pass so slowly through the sac as to allow of complete coagulation, and a spontaneous cure. In the fusiform aneurism this is not readily effected, owing to the smoothness of the lining membrane and the comparatively equal dilatation of the vessel, the blood sweeping off any coagulum from the walls of the sac; but as the lining membrane becomes irregular from the deposition of atheromatous matter, and assumes the granular appearance formerly alluded to, the blood-particles tend to become arrested, partly on this account, and partly owing to the diminishing force of the blood-current brought about by the establishment of the collateral circulation.

In the saccular or lateral true aneurism, the different steps of the process are very well illustrated, and the tendency towards a successful

issue is much more considerable than in the fusiform variety. Here, from the greater irregularity of the internal surface of the sac, particles of fibrine readily attach themselves, so as to form a clot; the determination of the blood to the collateral branches is also well marked; and as the sac increases in size its cavity is more and more removed from the influence of the current in the artery, so that a degree of stagnation ensues, which is extremely favourable to the occurrence of coagulation. This, in the first instance, takes place at the parts of the sac most distant from the circulation, and it goes on until a large mass of clot has accumulated. After a time the colouring matter of the clot becomes absorbed, and at last we find the sac of the aneurism filled with a mass of decolorised coagulum arranged in strata, and partly connected with the lining membrane by means of an exudation of plastic lymph. The natural cure is thus all but completed, and it would be completed in many cases were it not that the continual agitation of the blood at the mouth of the sac prevents entire coagulation, and by-and-by tends to undo the work which has been accomplished. It breaks down the clots already formed, and once more exposes the sac to dilatation and enlargement, which may steadily proceed until rupture takes place—a result the more likely to occur if the force of the blood in the sac be not greatly abated by the establishment of the collateral circulation.

In the fusiform aneurism, as has been already remarked, these changes take place less perfectly, and it may be added that the risk of a return of the disease after the collateral circulation is established is more to be apprehended in such a case.

Important indications for treatment are derived from these tendencies on the part of nature in effecting her cure; but before considering the treatment let us notice the DIAGNOSTIC SYMPTOMS of the disease, as these will vary in each variety, and according to its stage of progress. In the first stage an almost invariable symptom of a true aneurism is pulsation, equal in all directions, expansile in character, and synchronous with the heart's action. The tumour also, though tense and elastic, can, by gradual compression, be effaced, its contents being temporarily pressed into the vessel with which it communicates; but on removal of the pressure it fills again with a bound, and pulsates as before. It is affected in like manner by direct pressure on the main trunk higher up, this rendering the sac at once flaccid, and stopping all pulsation in it. There is a peculiar *bruit* audible in most aneurisms. Its presence will depend partly on the form of the sac, and partly on the condition of its contents, as, for instance, to what extent a coagulum may have formed; but one condition, when present, very markedly gives rise to it, namely, a comparatively small opening or neck to the sac; the peculiar rushing sound is then heard very loudly. It often exists in other circumstances, but, as a rule, it is not so marked when the opening is large, for the blood then flows into the sac more smoothly and slowly. In the ovoid or fusiform variety, the *bruit* is very peculiar. It is sometimes double, but on the whole it is *sui generis*, and scarcely admits of description. These, then, are the symptoms of aneurism in its first stage, that is, before coagulation has

taken place to any extent. The pulsation is equable throughout the sac; there is generally a *bruit* present; and the tumour is capable of being obliterated by pressure.

In the second stage, after coagulation has occurred, the symptoms are modified. The pulsation is still full and expansile, but not now equally forcible at all points, for in the greater part of its extent the sac is filled with coagulum, and thus protected from the force of the blood, which can only act strongly upon those parts where little or no clot exists. This fact accounts for the inequality of the pulsation as felt externally. Again, we can no longer efface the tumour by pressure, nor can we make it completely flaccid by compressing the main trunk, for both these processes are interfered with by the presence of the coagulum. In this stage certain local symptoms, which vary in their nature according to the seat of the disease, are complained of by the patient. The tumour, as it is now nearly in the condition of a solid mass, gives rise to symptoms which did not exist in the same degree when its contents were still fluid. In carotid aneurism, for example, there may be symptoms of spasmodic or constant difficulty of breathing from pressure on the upper part of the trachea, and in popliteal aneurism intense pain may be felt in the limb from pressure on the popliteal nerve, though this may be present to a less extent even when the contents of the sac are fluid. As the disease advances, the tumour may press upon the larger veins, and œdema of the limb will be the result. In the upper extremity, especially, this symptom is of very frequent occurrence. Again, if the tumour attain to a very large size it may lead to gangrene of the limb, from the pressure on the veins and on the collateral branches causing the circulation to be almost completely arrested. Lastly, by the constant pressure which it exercises upon all surrounding parts, it will alter and condense the soft texture, and eat out, by corrosion, any bony surface with which it may come into contact.

An aneurism, if allowed to go on without treatment, may terminate in various ways. It may rupture, causing effusion of blood and coagula into the tissues of the limb, and some have called such a case a false aneurism, but this leads to confusion, and it is therefore better to consider it as a true aneurism which has become diffuse in the last stage. Rupture, again, may occur through the skin, or into one of the internal cavities, causing the sudden death of the patient; and, lastly, the sac may not rupture, but go on enlarging until it attains an enormous size, the blood of the patient being more and more withdrawn into it from the circulation, so that he may finally become exhausted by anæmia and constant pain, and die by a gradual asthenia. This, however, rather applies to the cases which come under the care of the physician.

In certain cases of febrile disease we occasionally meet with acute ulceration of all the coats of an artery at some one point, without any appearance of the usual atheromatous or other deposit, and in such cases the blood is directly effused into the cellular tissue of the neighbourhood, where it forms a diffuse aneurismal swelling. This, however, is very rare. The preparation I now show you is such an aneurism of the carotid, which occurred in a patient recovering from typhus fever.

LECTURE LXV.

Treatment of Aneurism: Historical Sketch of the views formerly held regarding it—Hunter's Principles, and the Modifications which have resulted from them—Brasdor's Method—Risks and Contingencies attending the various plans of Treatment—Precautions necessary to meet these—Ultimate Resource: Amputation.

FORMERLY, when the circulation was not understood, and when the pathology and tendencies of the disease were less known, the treatment was without any fixed principle. One of the earliest methods consisted in applying direct pressure upon the tumour, with the view of preventing its growth, and finally obliterating it if possible. When this failed to effect a cure, the surgeon laid open the sac, turned out its contents, and tied the vessel above and below, just as is done now-a-days in cases of false aneurism. This, however, was found not to be a very successful mode of procedure, for the diseased and friable condition of the artery at the seat of the ligature often rendered its application difficult, and in the subsequent process of its separation secondary hæmorrhage was very apt to ensue. Surgeons, therefore, wisely devoted their attention to the methods by which nature effected her cure. In the medical treatment of aneurism, Valsalva first recognised this natural tendency, and in a certain degree followed out its indications. To diminish the force and frequency of the circulation, he had recourse to frequent depletion, and also the use of antimony and other depressants. The patient was kept perfectly quiet, and his supply of nourishment was gradually reduced to the minimum necessary to support life. These extreme depressing measures, however, were soon given up as ineffectual,—indeed, when carried beyond a certain point, the principle was erroneous. To obtain in the natural process of cure a firm coagulum, a certain amount of blood should be constantly supplied to the sac in order to furnish it with the necessary fibrine, and in the subsequent absorptive processes there is the effusion of lymph or plastic material; but in Valsalva's plan the whole treatment consisted in the diminution of the mechanical force of the blood, and the chances of firm coagulation in the sac were diminished from the want of plastic and fibrinous material. A modification of Valsalva's treatment, carefully carried out, has, in the practice of Mr. Tufnell of Dublin, yielded most gratifying results, and I would refer the reader to his work on the subject.* The next plan of treatment was that of Hunter, who still further carried out the indications of the natural process of cure.

* *The Successful Treatment of Internal Aneurism*, London, 1875.

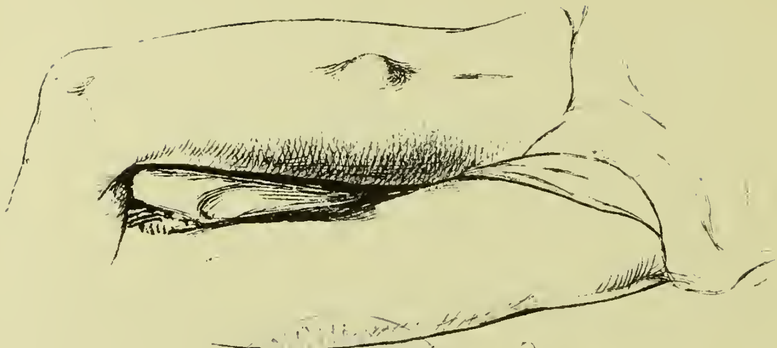


Fig. 1

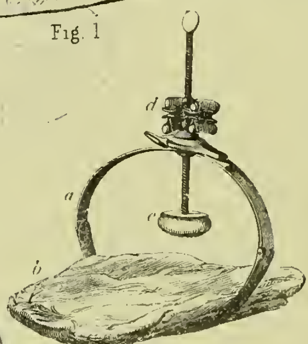


Fig. 3

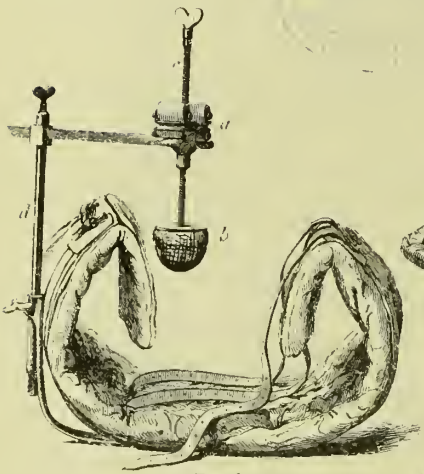


Fig. 2

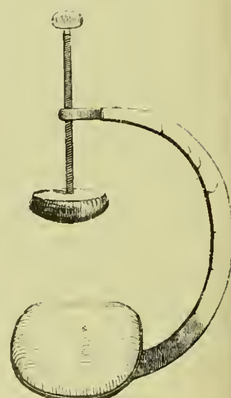


Fig. 4

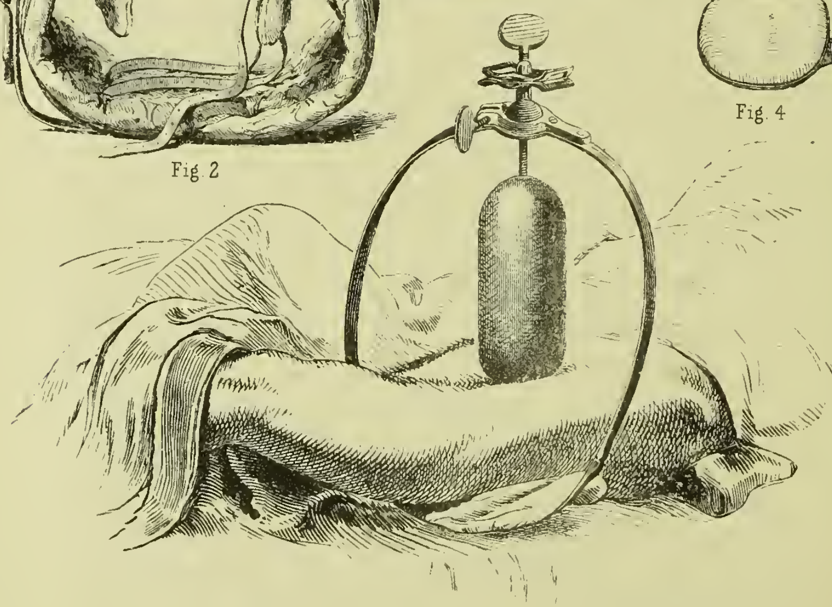


Fig. 5

He saw that what was wanted was the diminution of the force of the blood-current, not its complete arrestment; also that the blood might enter the aneurism by the collateral branches, and yet not interfere with the process of coagulation, rather, in fact, promote it, by continually depositing fresh fibrine. Hunter saw also that he could best accomplish his object by tying the vessel at some little distance from the aneurism, as this would give him a better chance of finding the coats of the artery in a healthy condition. He accordingly tied the femoral artery for popliteal aneurism at the part of its course where it lies encased between the tendons of the thigh in a sort of tube, called afterwards, in honour of him, Hunter's canal—the ligature being placed upon the artery at a point above the origin of the anastomotica magna branch. The great success of this mode of treatment soon established the soundness of Hunter's principle, which continues to hold its ground in the present day, although in the case of popliteal aneurism another locality has been selected as the seat of the ligature—namely, the lower angle of Scarpa's triangle; for the operation, while quite as effectual, is much more easily performed in this locality, and the ligature is applied further away from the disease, and from the large anastomosing branches given off lower down. The principle consists in tying the artery at some little distance from the aneurism, where we are likely to find the coats of the vessel in a healthy state. We thus prevent the direct influx of blood into the sac, and divert the current into the collateral branches, allowing coagulation to take place, layer after layer, until at last the tumour is converted into a perfectly solid mass. It then gradually diminishes in size, and becomes finally reduced by the process of absorption.

The same principle has, since Hunter's time, been carried out by other means than the ligature, for example by simple COMPRESSION. In the treatment by compression, pressure is applied upon the affected vessel on the proximal side of the aneurism,—on the superficial femoral, for example, in cases of popliteal aneurism.

This is effected either by pressure by the fingers of relays of intelligent assistants, who relieve each other at intervals, or by means of special apparatus, with which we exercise a graduated compression on the vessel at some distance on the cardiac side of the aneurism. The nature, forms, and mode of applying the different apparatus, will be better understood by looking at the plate than by any description. Compression slows or diminishes the force of the current of blood, and throws it upon the collateral branches, but not so abruptly as when the ligature is used, for the artery is rarely if ever occluded at the compressed point. The compression is continued until the coagulation has converted the tumour into a solid mass in the manner already described. The objections to this method seem to me to be that very few patients can bear the compression, and that it is also by no means so certain as ligature of the vessel, which operation is often required after the compression has been used for some time.

Another method of slowing the current of blood through the sac is by *flexion*, which may be advantageously used along with compression. In popliteal aneurism, if we firmly flex the knee-joint, we find that the

pulsation ceases. We have stopped the flow of blood into the tumour by the flexion of the vessel on which it is situated. It must, of course, be done gently, and by gradually flexing the leg upon the thigh, and the thigh upon the pelvis, otherwise the patient will not be able to bear it. By the acute curves or flexures of the vessel, which we effect by this position, we are enabled to slow the blood-current, and to cause coagulation and consolidation of the contents of the sac. The apparatus required is very simple, and is similar to that used for the treatment of ruptured tendo Achillis. I have seen this method prove effectual in a case, the circumstances of which were peculiar, I have tied the femoral artery, and this had apparently cured the aneurism, but about eighteen months afterwards the tumour began to return very rapidly, and I then tried the treatment by flexion alone. This quite stopped the circulation, and the cure was permanent, the aneurism having never returned. It is not always quite safe, however, to trust to flexion alone. In the case of another man who had disease of the aorta and of the heart, and who was not in a favourable condition for tying the femoral artery, I employed flexion, and the aneurism became hard and solid, and was apparently cured in a very short time, but after some injudicious movements of the patient it suddenly gave way and became diffuse. Compression was immediately made upon the artery higher up, so that the diffusion of blood was very limited, and I at once tied the femoral in Scarpa's triangle, but subacute gangrene supervened, and secondary amputation was required. If, in this case, compression and flexion had been employed conjointly, an effectual cure might have been obtained and the risk avoided. In another case of popliteal aneurism, treated in hospital, I tried flexion and compression together for about six months, but without much effect, for the aneurism was a fusiform one. I then brought him into the hospital, where I tied the femoral, and a successful result has been obtained. Though the principle of all these methods is the same, I must say that I consider ligature of the superficial femoral for popliteal aneurism to be preferable either to flexion or compression. We may try flexion first, as a means of preparation for the ligature of the artery, and at the same time employ compression over the vessel in Hunter's canal; but the ligature, if properly applied, is certainly the most effectual.

There is still another method of treatment which seems at first sight to be directly opposed to correct principles,—that is, tying the artery on the distal side of the aneurism, at a healthy point beyond the aneurismal sac. We should suppose that the impulse of the blood on the sac when the current was arrested on its distal side would burst the aneurism, but it is found that on applying a ligature on the distal side of the tumour, the blood ceases to flow through the sac, though its impulse is communicated to it. We therefore produce a certain amount of stagnation in the sac, and so favour the occurrence of coagulation. This was the method proposed by Brasdor, and revived and modified by the late Mr. Wardrop.

Whatever plan of treatment we may adopt in a case of true aneurism, there are certain risks which must be kept in view. For example, the surgeon knows there is a risk of gangrene, arising from deficient

vascular supply, and this condition he must be prepared to avert if possible.

When an artery is tied, the blood is thrown upon the collateral branches, and in the case of a wounded artery the collateral circulation is generally sufficient for nutrition.

In aneurisms, while there are certain conditions which are not so favourable, there are others which favour the collateral circulation. The gradually increasing obstruction to the current of blood passing through the aneurism tends, as was previously explained, to send the blood into the collateral branches, and so to prepare them for carrying on the circulation. In ordinary circumstances we have a very large series of such branches, so that we need seldom fear any want in the collateral circulation. In aneurisms in the head and neck, indeed, there is a risk of the collateral circulation becoming too free, and forming a disturbing influence on the distal side. The immediate effect of deligation of an arterial trunk, however, as a general rule, must always be to weaken the circulation of the parts supplied by it. After the superficial femoral has been tied, there is an enlargement of the descending branches of the perforating arteries, and other vessels from the profunda, together with the branches of the external circumflex artery, which anastomose with the articular branches of the popliteal artery, and with the anastomotica magna; so that there is a free inosculation in and beyond the popliteal portion of the vessel. But when an aneurism exists in the popliteal space, the coagulation generally blocks up some of the articular arteries, so that the number of available collateral branches is diminished. There is at first, therefore, a risk of deficient circulation, and it is to be remembered that during this state any stimulation of the limb is liable to be followed by a subacute form of gangrene, to avoid which certain points in the after-treatment are to be attended to. After the ligature is applied, the limb should be very slightly bent, so as to relax the artery a little, and it should be wrapped in cotton wadding; but nothing must be applied which could possibly constrict the limb at any point. Lastly, the limb should be placed upon a water-pillow, so that there may be no undue pressure on any part of it, such as might prevent the free carrying on of the collateral circulation. At first the patient complains of coldness in the limb, and it feels colder to the touch than that of the opposite side. This often leads to great mischief, for the nurse may apply hot bottles to increase its heat, and nothing is more likely to give rise to sloughing or gangrene through over-stimulating a part which is so weak. The limb should be wrapped in cotton wadding, but no artificial heat whatever ought to be applied to it, and it should be kept as quiet as possible. If the patient complain of great pain, an opiate may be given, and the diet in all cases should be moderate, but not stimulating.

Where compression has been used to arrest the circulation, we find, if it be successful, that the enlargement of the collateral branches is principally confined to the immediate neighbourhood of the aneurism. When the superficial femoral has been ligatured, the collateral branches, such as the gluteal, the ischiatic, the great internal and external circumflex arteries, and other branches above as well as below the ligature,

become enlarged, and form a chain or network of anastomosing vessels, which carry on the circulation. When the vessel is compressed, its tube, as already said, is not occluded so as entirely to prevent the flow of blood, but only so as to slow its current; and hence the enlargement of the anastomosing branches may be more limited.

We have now to consider certain cases where neither the ligature, nor compression, nor flexion, is suitable. In some cases the patient complains of pain in the sac of the aneurism and along the course of the vessels, and there is perhaps some œdema in the neighbourhood. The pain increases at night, and there is a slight redness on the surface of the tumour; the pulse also is quick and irregular from the general disturbance of the circulation. These symptoms indicate inflammation of the aneurismal sac. This condition may terminate in two ways; either by the more rapid coagulation of the blood within the sac, or, more generally, by partial decomposition of the blood and suppuration. If the suppuration takes place slowly, a natural cure may be effected; but in many instances, when suppuration occurs, the abscess opens externally, and hæmorrhage comes on. Frequently, also, decomposition takes place, and portions of the broken-up and decomposing clot are carried into the circulation, and gangrene supervenes, or death results from embolism or blood-poisoning. When inflammation has occurred, the surgeon should not think of tying the artery until the excitement in the sac has subsided.

A more frequent condition is that the aneurism increases rather rapidly, and becomes pretty solid, causing pressure on the larger veins and on the collateral circulating branches. From these conditions œdema takes place, the limb assumes a mottled appearance, and has a lower temperature than usual, and symptoms of gangrene gradually come on. Sometimes, without the other symptoms, there may be great œdema from the venous obstruction, and from the pressure on the collateral circulation. If these conditions exist with a very large aneurism—say in the popliteal space—the case is unfavourable for ligature. In some cases, by tying the artery above the aneurism, the bulk of the tumour decreases, and an amelioration of the other conditions takes place. But where the symptoms are very much marked, with coldness of the limb, and a mottled appearance of the skin, the case is very unfavourable for ligature of the artery; and if there be any doubt whether a partial diffusion of the aneurism have taken place, the case is one where amputation is preferable to ligature, or any other mode of treatment. If we tie the artery when the limb is in this condition, the swelling will obstruct the collateral and venous circulation, and such obstruction, superadded to the diminished supply of blood consequent on the ligature of the main trunk, would almost certainly induce gangrene. Therefore, under such circumstances, amputation is preferable to ligature.

A true aneurism may burst and become diffuse, and gangrene of the limb may supervene. In this case also amputation is required. Where the aneurism has burst fairly into the limb, and where the collateral circulation is pressed upon by the mass of blood thus thrown out, there can be no question as to the propriety of amputation. In

certain cases of aneurism, however, in the axilla and elsewhere, we may first adopt the method of laying open the tumour, turning out the coagulated blood, and tying the vessel above the opening in the artery, so as to give the patient the chance of saving the limb without incurring much risk; but whenever gangrene is threatened, with coldness and mottling of the limb, then amputation must be performed. Amputation may also be preferred to ligature of certain arteries, such as the innominate, the ligature of which has almost uniformly proved fatal. In one case of aneurism of the second and third parts of the subclavian, where the patient was suffering great pain, the limb being cold, there was no choice but between amputation of the arm and ligature of the innominate artery. In that case I amputated the arm at the shoulder-joint, and tied the artery as near the outer side of the aneurism as possible. The patient went on well so far as regards the amputation; the aneurism diminished in size, and for some weeks a cure seemed to have been effected, but after a little the aneurism began to return in consequence of the irregular conduct of the patient; under proper treatment it afterwards again diminished in size, and it has not since enlarged. It is now about four years since the operation. Though the aneurism never entirely disappeared, it was very much reduced in size, and contained a considerable amount of solid matter. Whilst this case, properly speaking, was not a successful one, still I consider that if the arteria innominata had been tied, a fatal result would soon have taken place. If it had been a case of ordinary lateral aneurism, the cure would probably have been perfect, but the aneurism was a fusiform one, and therefore less amenable to treatment. Under similar circumstances, I would again resort to this plan of treatment, which was just Brasdor's operation of tying the vessel on the distal side of the aneurism, with the addition that we also removed the source of the attraction of the blood to the parts beyond the tumour, and so gave a greater chance of consolidation to the contents of the sac.

LECTURE LXVI.

Traumatic or False Aneurism: Diffuse and Circumscribed; Nature, Progress and Treatment—Aneurismal Varix; its Definition and Diagnosis—Varicose Aneurism: Symptoms and distinguishing Features—Treatment of the two Conditions founded on the Pathology of each.

A Traumatic or False Aneurism is nothing more or less than that which results from a wounded artery. When a vein is implicated as well as the artery, the symptoms are to a certain extent modified. The most common form is the *diffuse false aneurism;* the blood becomes diffused among the tissues, forming a sort of flattened mass over the course of the vessel, which communicates to it a feeling of pulsation. The blood continues to be poured out for some time, so that the effusion is generally considerable, causing the limb to be swollen and painful.

A false aneurism may also be circumscribed. For example, if the wound in the artery be small, and if pretty firm compression be applied at the time, the blood does not escape in large quantity or with great force into the limb, but gradually forms a sort of tumour, the cellular tissue becoming condensed and thickened so as to form a rounded sac, which completely circumscribes the effused blood, like the sac of a true aneurism, and in some parts of the body the anatomical disposition of the surrounding structures assists this limitation.

A circumscribed false aneurism in some degree approaches in character to true aneurism, in so far as the limitation favours consolidation of its contents, when the force of the proximal blood-current is intercepted or diminished.

The treatment which I consider the best in all cases of ordinary false aneurism, whether diffuse or circumscribed, with the exception of certain circumscribed false aneurisms of the femoral, is to cut down on the tumour, turn out the coagula, and tie the artery above and below the wounded point.

Suppose we are about to operate in a case of false aneurism at the bend of the arm:—A tourniquet is applied at the upper third of the arm to compress the brachial and so command the circulation during the operation, and the care of the tourniquet is confided to an assistant. The arm and forearm are held as straight as possible, and supine. The surgeon then makes a very free incision through the skin and superficial fascia, from above to below the swelling, taking care to avoid the larger superficial veins, or, where that is impossible, to secure them before proceeding further. This first incision must not be made at

FALSE ANEURISM.

Plate XXV

Fig. 1

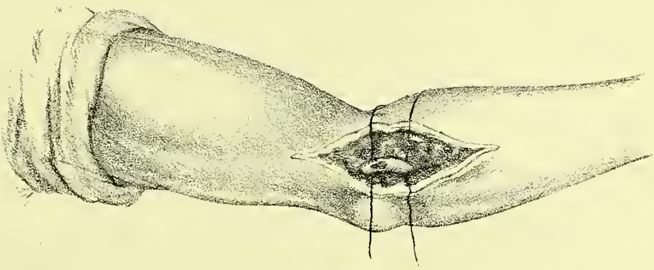


Fig. 2

Fig. 3

Waterston & Son Edin: Lith

random; for though our main objects are to open the sac, turn out the contents, and look for the wounded point, it is nevertheless very important to make the incision correspond to the course of the artery, so as to render the after-part of the operation more easy and certain. If we trust entirely to the cicatrix of the original wound as a guide, that may have been displaced by the swelling, and may not now correspond to the wound of the artery in the deeper part, and hence may mislead the operator. The incision above should be made along the inner edge of the biceps, and then carried down over the tumour with a slight degree of obliquity from above, downwards and outwards. When the first incision is completed, the strong glistening aponeurotic fascia, distended by blood, bulges out, forming a more or less rounded swelling (plate xxv. fig. 1). The operator makes an incision into this at the point which seems likely to correspond to the wound of the vessel, introduces his forefinger, and then with a probe-pointed bistoury enlarges the incision upwards and downwards to the full extent of the false sac, and turns out the coagula.

This method of opening the false sac is that usually adopted in cases where, as in the brachial, we can fully command the circulation on the cardiac side of the tumour; but in cases such as diffuse or traumatic aneurisms in the cervical or iliac regions, it must be modified. In such cases, the surgeon makes an incision that will barely enable him to insinuate his forefinger, so that it fills up the aperture. He breaks down the coagula within the sac, so that they may be turned out rapidly, and then feels for the opening in the artery, to which he is guided by the flow of warm blood. Keeping his finger firmly pressed upon the wounded point, he rapidly lays open the sac, and turns out its contents, so as to be ready to deal directly and at once with the vessel.

In the case of the brachial, when the clots are evacuated, the wound in the artery can sometimes be readily seen, and then ligatures are applied above and below the opening in the vessel, and the operation completed (plate xxv. fig. 2). There is often, however, a difficulty in discovering the wound in the artery, and in such cases, after fairly clearing out the sac, the tourniquet should be slacked a little; this causes a gush of blood to flow from the opening in the artery, which can thus be readily detected. Both ligatures should be placed round the vessel before either is tied, for if the upper ligature be tied first, there may be great difficulty in finding the lower part of the vessel, which becomes flaccid and is not easily recognised: I have seen this occur in practice. Hence it is safer and quite as easy to apply both ligatures properly before tying either.

In false aneurism the coats of the vessel are perfectly healthy, thus differing essentially from the state of the arterial coats in true aneurism, and with the double ligature there is scarcely any danger of secondary hæmorrhage. One ligature alone cannot be trusted to effect a cure on account of the free retrograde circulation; the vessel must be secured above and below the wounded point.

Under the head of Traumatic or False aneurisms, I have to direct your attention to two peculiar forms of aneurismal disease—*Aneurismal*

Varix, and *Varicose Aneurism;* for although these conditions may arise from disease in some rare cases, they are much more generally caused by a wound implicating an artery and some neighbouring vein.

Dr. William Hunter was the first to draw special attention to arterio-venous disease, and to point out the two forms in which it occurs. Since then numerous cases of both have been recorded, and observations published in reference to their exact pathological conditions. In both diseases there is communication between the vein and artery; and therefore, as we might expect, there are several symptoms common to both. The similarity of name, and community of general symptoms, have led occasionally to some confusion in regard to treatment; and it is to be regretted that even some writers, who are distinct enough in their description of the two forms of disease, are not equally careful to keep cases of aneurismal varix separate from cases of varicose aneurism when discussing the subject of treatment. It is most essential to remember, in reference to treatment, that however much the two lesions may have in common as regards certain symptoms and appearances, such as the peculiar "bruit," the varicose condition of the neighbouring veins, or the constitutional affection arising from the admixture of venous and arterial blood, their pathological condition differs in one most important point bearing upon practice, and more especially upon the question of operative interference.

Keeping this in view, I shall now describe the symptoms and pathology of aneurismal varix and varicose aneurism, and next consider the rationale of the treatment of each.

In Aneurismal Varix the wound has implicated the artery, and some vein in close contact with it. The bleeding has been arrested by firm pressure at the time, and the parts have healed. The artery and vein adhere directly and closely at the wounded point, so that at each pulsation a jet of arterial blood is projected into the vein, dilating it and destroying the competency of its valves, and gradually leading to a varicose condition of neighbouring veins both deep and superficial. The force with which the arterial stream enters the aperture to the vein, and the meeting of the opposing blood-currents, give rise to a pulsatory movement in the affected veins, attended with a peculiar thrill, and a whizzing sound, which can often be heard even at a little distance. This sound has been compared to various noises—"the noise of machinery softened by distance," "the sound made by the fly-wheel of a watch much intensified;" perhaps the best is the somewhat ludicrous one—"the noise made by a blue-bottle fly confined in a thin paper bag." The sound, however, is so remarkable that it can hardly be mistaken for any other. In aneurismal varix, the affected vessels, both veins and arteries, undergo changes in structure and function. The arteries have been found dilated and attenuated in their coats, so as to resemble veins in being thin and distensible; and this condition

Fig. 81.

Fig. 81. Outline of Aneurismal Varix. Diagram.

is not limited to the part of the artery wounded, but extends for some distance, and even into the collateral branches. Whilst the neighbouring veins have their valvular structure impaired, and become tortuous and thickened, sometimes that portion of the vein in which the aperture of communication is situated, and which is more immediately exposed to the force of the arterial current, yields, bulges, and forms a remarkable, pulsating, dilatation. There is, however, no formation of an aneurism; for though the natural course of the circulation is disturbed, there is no such obstruction or resistance to the blood-current as takes place in aneurism, and hence there is little risk of such distension as would lead to rupture of the dilated vessel, or of ulceration occurring as in the case of an aneurism. This diseased condition therefore may exist for years, or the greater part of a lifetime, without any marked alteration locally, except perhaps a larger number of veins becoming varicose and pulsating. In some cases, however, it has been observed that patients suffer in general health, owing to the admixture of venous with arterial blood. But in many cases of this form of arterio-venous disease, nothing except the local changes are observed.

Varicose Aneurism consists in the formation of an aneurism, the sac of which has communication with both the artery and vein, and the blood from the artery is projected from the intermediate sac into the vein. Dilatation of the vein implicated, and also of the neighbouring veins, takes place, as in the aneurismal varix, and is accompanied by the same peculiar "bruit," and pulsatory motion in the vein. This form of aneurism is, as I have already said, generally the result of wound. In the first instance, probably, the compression has not been so effectual as to prevent some blood being extravasated, or to maintain the wounded vessels in perfectly close apposition, and hence blood escapes into the cellular tissue, separating them to a greater extent. The cellular tissue and the textures around become condensed by effused lymph, and thus a false aneurism is formed intermediate between the vein and artery, and common to both these vessels.

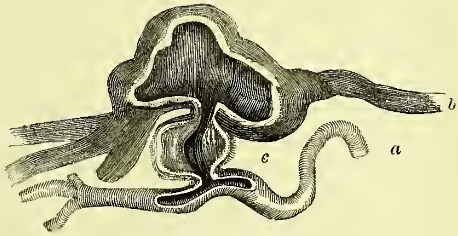


Fig. 82.

The distinguishing features of arterio-venous aneurism are—the varicose state of the veins of the affected part; the pulsatory vibrating sensation felt, or even seen, in these varicose veins; the peculiar whizz or "bruit," more extensively heard towards the trunk than in the distal part of the tumour; the comparative slowness with which the sac enlarges; and the little prominence of the swelling. Most of these peculiarities depend on the abnormal communication with the neighbouring vein. The pulsatory varix, and the peculiar "bruit" are common to varicose aneurism and aneurismal varix, and the causes of their

Fig. 82. Varicose aneurism. *a*, The artery; *b*, the vein; *c*, the intermediate cyst—Sir Charles Bell.

symptoms are similar, and so obvious that I need not repeat what I said when speaking of the latter disease. It differs as to its symptomatology by the presence of a distinct aneurism. I have said that occasionally in aneurismal varix that part of the vein in contact with the artery may bulge, and form a remarkable pulsating swelling, but it is merely a dilatation of the wounded vein, and not at all like the aneurismal tumour in varicose aneurism. In relation to ordinary false aneurism, it differs in respect of its free communication with the vein, on which account the blood-current in the anuerism meets with no resistance in that direction. There is little pressure on the walls of the sac, and hence the comparatively slow enlargement and little prominence of the tumours, for the blood-current does not impinge with much force on the walls of the sac, but finds its way into the circulation through the veins. This last-mentioned condition is most important as to its bearing on the treatment.

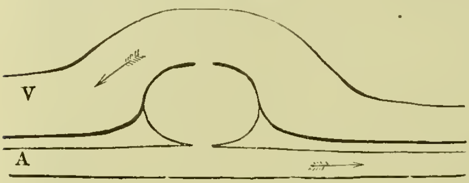


Fig. 83.

The *Treatment* of these two conditions of arterio-venous disease is founded on a consideration of their pathology. In aneurismal varix we have seen that although there is some alteration in the structure and function of the vessels affected, there is no resistance to the blood-current. There is little more than mère dilatation of the vein connected with the artery, and hence little tendency to such distension as would be likely to lead to rupture or ulceration, and the history of such cases shows us that the disease may exist for years without any great alteration taking place. In aneurismal varix, therefore, operative measures are seldom called for, and all that requires to be done is to give support to the circulation, and prevent further venous dilatation, by bandaging the limb from below upwards, or by the use of elastic or laced stockings.

In varicose aneurism, on the contrary, we cannot leave the disease to take its own course, for though it might be slow in its progress, it would certainly continue to increase, and ultimately either become diffuse throughout the limb, or ulcerate and give way externally. We therefore must have recourse to active treatment. Compression, even at an early stage of the disease, does not answer well, owing to the distended state of the veins, and seems to produce more local irritation and œdema than when applied in other forms of aneurism. The operation of ligature is the best plan of treatment. In the varicose aneurism at the bend of the elbow, the usual plan has been to treat it as a case of ordinary false aneurism, by the direct method of cutting into the sac, and tying the artery above and below the wounded point, and in that region this answers well enough. In other parts of the body, as, for example, the thigh, the plan would be attended with great risk, from the implication of the femoral vein. Mr. Hodgson, in his work on the bloodvessels, recommends ligature of the femoral by the Hunterian plan, trusting that coagulation would take place within the

Fig. 83. Outline of varicose aneurism. Diagram.

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sac, and that the wound of the vein would heal. But the communication through the sac with the vein would offer a free passage for the retrograde circulation; and that, together with the reflux venous current, would form obstacles to coagulation which do not exist in a circumscribed false aneurism, so that the analogy does not hold. The only two cases I can find, in which the Hunterian method was tried, proved fatal. One occurred in the practice of the late Sir Wm. Lawrence. In it gangrene supervened, amputation was resorted to, and the patient died. The other, a case of varicose anuerism in the popliteal region, resulting from gunshot wound, is recorded by Dr. Dorsey, of Philadelphia. In that case the femoral artery was tied, and fatal secondary hæmorrhage took plaee. In a case which came under my own care lately, after full consideration of all the circumstances, I operated by placing ligatures on the femoral, both above and below the anuerismal tumour, without opening the sac, so as at once to avoid interference with the vein, and to cut off the disturbing influence of the retrograde current of arterial blood, and so favour consolidation of the contents of the sac. The plan answered my fullest expectations, and I believe it to be the proper procedure in varicose aneurism of the femoral, and even in the brachial, although, as I said, in that region the risk of the ordinary operation is less. The principle of the procedure is to tie the vessel above and below the aneurism, so as to prevent either direct or retrograde blood-current interfering with coagulation and obliteration, whilst we avoid interference with the vein, which we cannot do if we open the aneurism, as the vein communicates with it. (See illustrative Clinical Cases, vol. ii.)